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INTRODUCTION

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02 AIRCRAFT
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11 FACILITIES, RESEARCH AND SUPPORT

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **1231**

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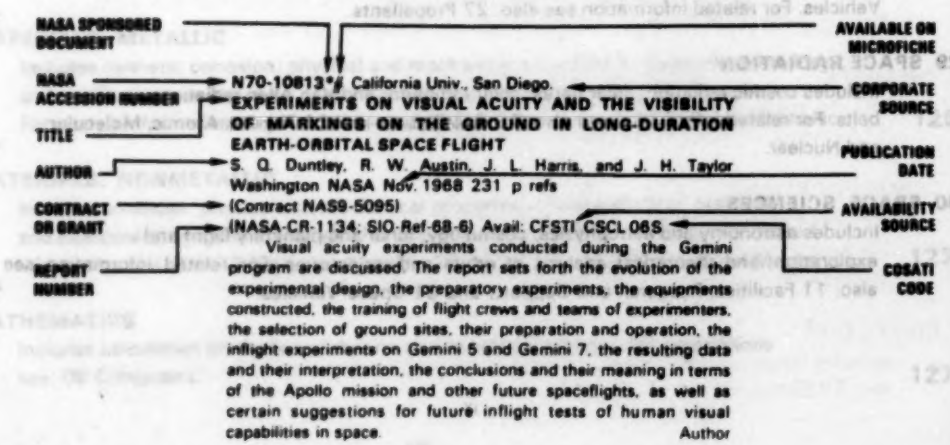
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AUTHOR
S. Q. Duntley, R. W. Austin, J. L. Harris, and J. H. Taylor
PUBLICATION DATE
Washington NASA Nov. 1968 231 p refs
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REPORT NUMBER
(NASA-CR-1134; SIO-Ref-68-6) Avail: CFSTI CSCL 06S
COSATI CODE
Visual acuity experiments conducted during the Gemini program are discussed. The report sets forth the evolution of the experimental design, the preparatory experiments, the equipments constructed, the training of flight crews and teams of experimenters, the selection of ground sites, their preparation and operation, the inflight experiments on Gemini 5 and Gemini 7, the resulting data and their interpretation, the conclusions and their meaning in terms of the Apollo mission and other future spaceflights, as well as certain suggestions for future inflight tests of human visual capabilities in space.
Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N70-18358# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

A SYSTEM OF EQUATIONS FOR ANALYTICAL INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS OF EXTENDED BODIES AT HIGH ANGLES OF ATTACK [SYSTEMES D'EQUATIONS POUR L'ETUDE ANALYTIQUE DES CARACTERISTIQUES AERODYNAMIQUES DES CORPS ELANCES AUX GRANDES INCIDENCES]

P. P. Ryaboshapka [1969] 20 p refs In FRENCH and RUSSIAN Transl. into FRENCH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 2, 1968 p 3–11

(LRBA-69-0363) Avail: CFSTI

The analytical determination of vortex circulation is investigated and construction of engineering equations for calculating vortex intensity is considered. The spatial problem of flow is solved by first deriving potential equations of unsteady vortex flow in a moving two-dimensional surface. The third coordinate is regarded as the fictional time for the formation of vortex flows. An extended body with an arbitrary cross-sectional configuration is considered, which is oriented at an angle of attack to the flow of a continuous medium. The derived formulas may be used in both subsonic and supersonic flow, calculation of the latter being accomplished by special values of Mach number. Transl. by R.B.

N70-18438 National Lending Library for Science and Technology, Boston Spa (England).

RESULTS OF TESTING AXIAL TURBINE STAGE MODELS WITH RADIAL LOADING OF THE GUIDE BLADES [REZUL'THTY ISPYTANII MODELEI OSEVOI TURBINNOI STUPENI S RADIAL'NYM NAVALOM NAPRAVLYAYUSHCHIKH LODATOK]

I. G. Gogolev et al 29 Aug. 1969 9 p refs Transl. into ENGLISH from Energomashinostroenie (Moscow), v. 14, no. 9, 1968 p 19–21 In RUSSIAN and ENGLISH

(NLL-Trans-4354-(9022.31)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Results are given of tests on four models of one axial turbine stage with different blade radial inclination angles. Relationships between root and peripheral reaction, the velocity ratio and angle of radial inclination, and the efficiency of the model and operating conditions are established. Results show that radial inclination of the guide blades is an effective means of controlling the aerodynamic characteristics of an axial turbine stage. Author

N70-18544# Texas Univ., Austin. Dept. of Aerospace Engineering.

RESEARCH ON ELLIPTICAL AIRFOIL WITH JET CIRCULATION ON CONTROL Final Report

J. W. Yuan, J. C. Westkaemper, and J. S. Kishi Jan. 1969 87 p refs

(Contract N00014-67-A-0126)

(AD-697179) Avail: CFSTI CSCL 1/3

Results are presented from an experimental investigation of the performance characteristics of elliptical airfoils with a jet-flap. Several 18% elliptical airfoils with 12-inch chord were tested in a subsonic wind tunnel. Circulation control was provided by ejecting air from the model airfoil through spanwise slots in the trailing edge of the airfoil. Tests included models mounted with a sweep angle with the tunnel flow direction, with spanwise variation in jet slot width, and with different jet-flap angles. The results are presented in graphical form for the purpose of comparing characteristics. Author (TAB)

N70-18570*# National Aeronautics and Space Administration, Washington, D.C.

STATUS OF PASSIVE INFLATABLE FALLING-SPHERE TECHNOLOGY FOR ATMOSPHERIC SENSING TO 100 km

1969 307 p refs Symp. held at Langley Station, Va., 23-24 Sep. 1969

(NASA-SP-219) Avail: CFSTI CSCL 01A

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10. REQUIREMENTS FOR TRACKING RADAR FOR FALLING SPHERES J. L. Hain and W.E. Brockman (Booz-Allen Applied Research, Inc., Dayton, Ohio) p 175-185 refs (See N70-18580 07-07)

11. THE TONE RANGE/TELEMETRY INTERFEROMETER TRACKING SYSTEM FOR SUPPORT OF SOUNDING ROCKET PAYLOADS J. I. Hudgins and J. R. Lease (NASA, Goddard Space Flight Center) p 187-226 refs (See N70-18581 07-14)

12. SOME PROPERTIES OF DATA FALLING SPHERE SOUNDINGS R. S. Quiroz (Weather Bureau, Suitland, Md.) p 227-256 refs (See N70-18582 07-20)

13. DATA FROM FALLING SPHERE EXPERIMENTS INCLUDING COMPARISON TESTS BETWEEN DIFFERENT SYSTEMS L. B. Smith (Sandia Corp., Albuquerque, N.Mex.) p 257-270 refs (See N70-18583 07-01)

14. RESULTS FROM SEVERAL EXPERIMENTS AT WHITE SANDS MISSILE RANGE AIMED AT ASSESSMENT OF FALLING-SPHERE DENSITY DATA R. Olsen (White Sands Missile Range, N.Mex.) p 271-279 refs (See N70-18584 07-01)

15. METEOROLOGICAL DATA FROM FALLING SPHERE TECHNIQUE COMPARED WITH DATA FROM OTHER SOUNDING METHODS W. S. Smith (NASA, Goddard Space Flight Center) p 293-300 refs (See N70-18585 07-13)

N70-18576*# Minnesota Univ., Minneapolis.

AN ASSESSMENT OF SPHERE DRAG COEFFICIENT DATA

Helmut G. Heinrich and Robert A. Noreen *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 93-100 refs (See N70-18570 07-01)

Avail: CFSTI CSCL 01A

In order to reliably determine atmospheric conditions from the descent velocity of a sphere, the drag coefficient of the sphere as it falls through the air must be known to a high degree of accuracy. This paper covers wind tunnel studies which established drag coefficients from 360,000 ft. altitude down for a one meter sphere with a given weight, when ejected from a rocket at an altitude of 450,000 ft. The wind tunnel test conditions were adjusted for simultaneous duplication of the Mach and Reynolds Numbers as they occur during the descent of the sphere in a standard atmosphere. The range of the test conditions was wide enough to cover the expected atmospheric deviations. Author

N70-18577*# Dayton Univ. Research Inst., Ohio.

HIGH ALTITUDE ROBIN DATA-REDUCTION PROGRAM

James Luers and Nicholas A. Engler *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 111-143 refs (See N70-18570 07-01)

Avail: CFSTI CSCL 01A

The problem of computing winds and thermodynamic data utilizing the space-time coordinates of a falling sphere becomes complex when the apogee of the sphere is over 100 km. This paper describes the methodology used in constructing the computer program. Author

N70-18579*# Utah Univ., Salt Lake City.

A CAPABILITY MODEL FOR PASSIVE SPHERES AT HIGH ALTITUDES

Forrest L. Staffanson and R. Gary Phibbs *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 165-174 refs (See N70-18570 07-01)

Avail: CFSTI CSCL 01A

An error model for passive sphere systems at high altitudes is formed by using time derivatives from a low pass filter bounded by cutoff frequency and input amplitude and the associated temperature uncertainties. Quantitative comparison of sphere results with results from other atmospheric sounding techniques indicates that deviations are attributable to the smoothing interval used. It is recommended that data reduction programs include automatic calculation of the point-to-point uncertainty and present a measured parameter from a given sounding so that the density profile plot will be a curve of varying width within which the measured density lies with a stated probability. G.G.

N70-18583*# Sandia Corp., Albuquerque, N.Mex.

DATA FROM FALLING SPHERE EXPERIMENTS INCLUDING COMPARISON TESTS BETWEEN DIFFERENT SYSTEMS

Lawrence B. Smith *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 257-270 refs Supported by AEC (See N70-18570 07-01)

Avail: CFSTI CSCL 01A

A discussion is given of the falling sphere program. The 30 experiments conducted between October 1964 and June 1969 are categorized according to their results. The results from a series of comparison tests made in May 1968 between a variety of systems used to measure density are also discussed with emphasis on possible system errors. It is concluded that more effort needs to be expended to determine the size of errors arising from drag coefficient uncertainties and velocity and acceleration measurements. Author

N70-18584*# White Sands Missile Range, N.Mex. Atmospheric Sciences Lab.

RESULTS FROM SEVERAL EXPERIMENTS AT WHITE SANDS MISSILE RANGE AIMED AT ASSESSMENT OF FALLING-SPHERE DENSITY DATA

Robert Olsen *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 271-279 refs (See N70-18570 07-01)

Avail: CFSTI CSCL 01A

Density measurements utilizing inflatable passive falling spheres were made. Two different rocket vehicle systems used to deploy the sphere at apogee to demonstrate the capabilities of each of these systems in providng high-altitude data. Five sets of density data computed from a total of fourteen flights were compared with density data derived from rocketsonde soundings and the 1966 Standard Atmosphere. A negative density departure from the 1966 Standard Atmosphere was shown to exist between 70 and 80 km. Two sets of density data were derived from each flight. Density data computed from these flights were compared with density data derived from rocketsonde soundings and the 1966 Standard Atmosphere. These comparisons indicate varying agreement; however, no conclusions can be made because of the limited number of comparisons. Author

N70-18664*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

AN EXPERIMENTAL STUDY OF BLADE TIP VORTICES

Raymond Piziali and Andrew Trenka Jan. 1970 86 p refs (Contract NAS1-8117)

(NASA-CR-66860; CAL-AC-2647-s-1) Avail: CFSTI CSCL 01A

An initial experimental investigation was conducted to determine the influence of tip shape on the tip vortex formation and the aerodynamic performance of lifting surfaces representative of typical helicopter rotor blades. The objective was to assess the potential for beneficially altering the generation of the tip trailing vorticity by proper design of the tip. Flow visualizations and force measurements were made in a wind tunnel on a semi-span model wing at free-stream velocities of nominally 100 fps. Six different tip configurations were investigated at free stream velocities of nominally 100 fps. The wind had a NACA 0012 airfoil, a 13-3/4 inch semispan, and a constant 3 1/2 inch chord except at the tip. The test Reynolds number was nominally 190,000. The external flow about the tip was visualized with an oil smoke and the surface

flow with a pigmented oil. Some of the results of both visualization techniques are presented and discussed for each tip configuration. An additional sequence of smoke flow photographs which clearly show the details of the tip vortex formation on a square tip is also presented. Author

N70-18666*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESIGN CHARTS OF STATIC AND ROTARY STABILITY DERIVATIVES FOR CROPPED DOUBLE-DELTA WINGS IN SUBSONIC COMPRESSIBLE FLOW
John E. Lamar Washington Feb. 1970 81 p refs
(NASA-TN-D-5661; L-6716) Avail: CFSTI CSCL 01A

An evaluation of a modified version of the Multhopp subsonic lifting surface theory was made by comparing the theoretical values with experimental data. Near zero lift, the theory was found to predict reasonably adequately the lift curve slope, aerodynamic center, damping in roll, damping in pitch, and lift coefficient due to pitch rate for delta and cropped delta planforms and also the lift curve slope for double-delta planforms. Based on this theory, a series of design charts has been prepared for cropped double-delta planforms in subsonic compressible flow. Author

N70-18668*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF GROUND PROXIMITY ON THE LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF AN UNSWEPT ASPECT-RATIO-10 WING
Arthur W. Carter Washington Feb. 1970 62 p refs
(NASA-TN-D-5662; L-6970) Avail: CFSTI CSCL 01A

A wind tunnel investigation has been made of the effects of ground proximity on the longitudinal aerodynamic characteristics of an unswept wing with an aspect ratio of 10 and a taper ratio of 0.3. Data were obtained throughout a range of heights of the wing above a stationary and moving belt ground plane with flaps retracted and with full span double slotted flaps deflected 30 deg and 50 deg. Author

N70-18765*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC STABILITY, CONTROL, AND FIN LOAD CHARACTERISTICS OF A MODEL OF AN APACHE VEHICLE WITH A COAST-PHASE-CONTROL PACKAGE
William J. Monta Washington Feb. 1970 35 p refs
(NASA-TM-X-1942; L-6835) Avail: CFSTI CSCL 01A

An investigation has been conducted in a wind tunnel at Mach numbers from 1.60 to 2.87 to determine the aerodynamic characteristics of a model of an Apache second-stage vehicle equipped with a coast-phase-control system section having interdigitated movable cruciform fins. The results indicated a pitchup tendency that becomes more pronounced with increasing Mach number. The fins were effective in producing pitch and roll control throughout the test range of angle of attack and Mach number. At the higher angles of attack, roll-control deflection induced some adverse yawing moments. Author

N70-19143# Aeronautical Research Labs., Melbourne (Australia).
THE LIFT DISTRIBUTION NEAR THE TRAILING EDGE OF SLENDER WINGS. PART 2: OSCILLATORY DERIVATIVES AND GUST RESPONSE FUNCTIONS FOR SUBSONIC ATTACHED FLOW
E. D. Poppleton and P. A. Schmid May 1969 44 p refs
(ARL/A-267A) Avail: CFSTI

An approximate analysis is made of the effect of the trailing edge on the lift distribution on an oscillating slender wing. Constants in the equations are determined from experiments specially designed for investigating the trailing-edge effect. Measurement calculations of other workers shows good agreement. Author

N70-19259*# Techtran Corp., Glen Burnie, Md.
STUDY OF SUPERSONIC COMPRESSORS [ETUDE DE COMPRESSEURS SUPERSONIQUES]
O. Conrad et al Washington NASA Feb. 1970 22 p refs Transl. into ENGLISH from AGARD-CP-34, Pt. 1, 1969 p 15-1 – 15-22
(Contract NASw-1695)
(NASA-TT-F-12830; AGARD-CP-34-Pt-1) Avail: CFSTI CSCL 20D

Based on measuring data for a number of supersonic cascades, assumptions were made on presumably obtainable total pressure ratios in shock-in rotors, impulse rotors and guide vanes. Starting from these assumptions, the stage pressure ratios were calculated and compared for supersonic compressors with shock-in rotors and impulse rotors. According to these calculations, the impulse compressors are better for smaller ratios, whereas the shock-in compressors are better for high pressure ratios. Furthermore, it is clearly shown that there exists an obvious connection between the diffusion factor and the loss coefficient for a very carefully measured high deflecting supersonic rotor, and that the calculated loss coefficient coincides fairly accurately with the measured value. Author

N70-19265*# Techtran Corp., Glen Burnie, Md.
STUDY BY HYDRAULIC ANALOGY OF WAVE CONFIGURATIONS IN SUPERSONIC COMPRESSORS [ETUDE PAR ANALOGIE HYDRAULIQUE DE LA CONFIGURATION D'ONDES DANS LES COMPRESSEURS SUPERSONIQUES]
Roland Sovrano et al Washington NASA Feb. 1970 19 p refs Transl. into ENGLISH from AGARD-CP-34, Pt. 1, 1969 p 8-1 – 8-10
(Contract NASw-1695)
(NASA-TT-F-12826; AGARD-CP-34-Pt-1) Avail: CFSTI CSCL 20D

Hydraulic analogy is used in an experimental set-up of a rotating annular cascade in a free surface water tank, where the shock wave and the expansion line pattern in the front of the cascade are visualized. The cascade rotates with a velocity greater than the velocity of the surface waves. Because of the periodicity of the blades, such a set-up gives flow patterns encountered in actual axial compressors. Two different flow models are analyzed: conventional supersonic compressors with subsonic axial flow velocity, similar to the transonic aircraft compressors, and advanced supersonic compressors with supersonic axial flow velocity, well adapted to high Mach number aircraft. In both cases, experiments show a high flow incidence angle at the cascade inlet and normal shock waves in the blade channels. Author

N70-19315*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF MODIFICATIONS TO BLUFF TENSION SHELL SHAPES ON AERODYNAMIC CHARACTERISTICS AT MACH 3.0
James Wayne Sawyer and William D. Deveikis Washington Feb. 1970 32 p refs
(NASA-TM-X-1949; L-6253) Avail: CFSTI CSCL 01A

A wind-tunnel investigation was conducted to determine the static longitudinal aerodynamic characteristics of spherically blunted bluff tension-shell decelerator shapes for flow turning angles (surface slope at the base) between 67 and 90 deg and of tension shell shapes with a spherically blunted 120 deg cone forebody having a projected frontal area approximately 30 percent of that of the tension-shell base. Tests were conducted at a free-stream Mach number of 3.0, at a free-stream Reynolds number, based on original base diameter, of approximately 3.0 million, and at angles of attack to 12 deg. Author

N70-19687# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
CALCULATION OF ANGLE OF EMERGENCE OF FLOW FROM PLANAR TURBINE GRID [DETERMINATION DE

L'ANGLE DE L'ECOULEMENT A LA SORTIE D'UNE GRILLE D'AUBES PLANES]
O. V. Karassev [1969] 12 p refs *In* FRENCH and RUSSIAN
(LRBA-69-0960) Avail: CFSTI

A method is discussed for calculating turbine flow angle of emergence taking into account the geometric parameters of the grid profile and outflow conditions. Transl. by E.C.

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N70-18315# Army Foreign Science and Technology Center, Washington, D.C.
SOVIET HELICOPTERS
20 Oct. 1969 12 p refs Transl. Krylya Rodiny, (USSR), no. 2, 1969 27 p
(AD-696192; FSTC-HT-23-685-69) Avail: CFSTI CSCL 1/3

General information is presented concerning the role of Soviet helicopters in the national economy. Details are provided concerning the development and testing of early Soviet helicopters, including the TsAGI 1-EA, and 5-EA models. Author (TAB)

N70-18318# RAND Corp., Santa Monica, Calif.
THE BIG STEP FROM TECHNOLOGY TO OPERATIONAL SYSTEMS
G. K. Smith Nov. 1969 8 p Presented at V/STOL Technol. and Planning Conf., Las Vegas, Nev., 23-25 Sep. 1969
(AD-697057; P-4181) Avail: CFSTI CSCL 1/3

The text is given of a talk made at a conference largely devoted to the technical aspects of V/STOL systems. It concerns the final payoff from technology advances which comes when that technology is translated into operational systems. Author (TAB)

N70-18433 National Lending Library for Science and Technology, Boston Spa (England).
SOUNDING THE LOWER ATMOSPHERE BY A MODEL, REMOTE-CONTROLLED AIRCRAFT
H. Bardeau 21 Oct. 1969 13 p refs Transl. into ENGLISH from Soc. Ital. Geofis. Met., Geofis. Met. (Genoa), no. 17, 1968 p 13-17
(NLL-M-7811-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

A technique for sounding the lower atmosphere, between 0 and 1,500 m, with a model plane operated by remote control, is described. The plane is designed to reach a height of 2,000 m carrying a load of 2.5 kg. It is equipped with a 72 MHz quartz controlled transmitter with a power of 200 mw, permitting transmission to ground of temperature and pressure parameters. The plane carries out both vertical and horizontal radio-soundings. The thermometric probe mounted on the plane has a response time of 0.2 s; its sensitiveness of 250 Hz per degree gives a precision to within 1/10 of a degree on non-stop analogical recordings. The qualities of accuracy and precision of this probe, together with the advantage of using a remote-controlled plane as a means of transport, permit the study of the fine structure of the thermal turbulence of the lower atmosphere. Author

N70-18515# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT CENTRIFUGAL PUMP UNITS
L. S. Arinushkin et al 4 Apr. 1969 336 p refs Transl. into ENGLISH from Aviats. Tsentrobezhn. Nasosnye Agregaty (Moscow), 1967 p 1-255
(AD-696488; FTD-MT-24-407-68) Avail: CFSTI CSCL 1/3

A general description of the experience of Soviet and foreign industry with respect to calculation, designing, experimental studies, and operation of aircraft centrifugal pump units is given. The contemporary level of designs and prospects of their development are discussed. Questions of the calculation of the maximum power altitude of centrifugal pumps, their operation in fuel systems with negative and zero overloads, and the influence on the pump operation of temperature and viscosity of a working fluid. Characteristics of the calculation of cavitational characteristics of centrifugal and axial pumps, basic dimensions of the flow-through area of the centrifugal pump, selections of optimal geometric dimensions of a preengaged axial wheel are given. Material connected with the selection of the type of drive optimum in weight to operating characteristics and dimensions is given. Original designs of the most widespread aircraft centrifugal pumps with electric drive are examined. Questions of the designing of hermetic pump units are touched upon. Peculiarities of the joint work of electric drive and the aircraft centrifugal pump are classified and generalized. The dynamics of the operation of the pump-electric drive system is revealed. An account is given of the bases of design, calculation and operation of the pumps with drive from air and hydraulic turbines. Author (TAB)

N70-18571*# Air Force Cambridge Research Labs.
A SUMMARY OF AFCRL PASSIVE-SPHERE DEVELOPMENT EFFORTS AND EXPERIENCE
John B. Wright *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 1-38 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 01C

A passive falling sphere, ROBIN, has been developed by the Air Force for atmospheric soundings between 100 and 30 km. The rocket vehicles and simple sphere have been developed to permit a relatively low cost per sounding. The radar space-time data are reduced to meterological parameters in a digital computer thereby providing nearly real time information. The sphere is a superpressure balloon fabricated from thin plastic (Mylar) and inflated by vaporization of isopentane. Certain problems in sphere hardware reliability have been solved while others remain. Collapse of the spherical balloon 5-15 km above the design altitude of 40 km persists. In order to calculate atmospheric density (temperature and pressure), a precise knowledge of the drag coefficient of a sphere over a wide range of flow conditions is required. The wind tunnel measurements currently being used with this system have areas that produce atmospheric data that either do not compare well with other sensors or have peculiar excursions. Author

N70-18572*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE IMPORTANCE OF ENVIRONMENTAL TESTING INCLUDING EXPERIENCE WITH THE ARCAS-ROBIN SYSTEM
Sammie D. Joplin *In its* Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 39-54 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 01C

The emphasis of this paper is on the selection of an environmental test plan that will result in the development of a reliable system for obtaining atmospheric measurements. First, the availability of facilities and then capability of providing a simulated environment for a falling-sphere system will be considered; then, the types of tests and test levels that have resulted in the development of successful flight systems. Finally, some techniques that can be used to simulate the environment of an inflatable falling sphere will be considered. Author

N70-19027# Air Force Systems Command, Wright-Patterson AFB, Ohio. Avionics Lab.

LIGHTNING AND STATIC ELECTRICITY CONFERENCE. PART 2: CONFERENCE PAPERS

May 1969 580 p refs Conf. held at Miami Beach, Fla., 3-5 Dec. 1968 Sponsored by AF and the Soc. of Automotive Engr.
(AD-693135; AFAL-TR-68-290-Pt-2) Avail: CFSTI CSCL 1/2

Problems of lightning and static electricity as they pertain to aerospace vehicles are discussed. Topics covered include fluids and fuels, grounding and bonding techniques, survivability of nonconductive materials in a lightning environment, and control of static electricity effects on nonconductive materials. For individual titles, see N70-19028 through N70-19060.

N70-19028# Air Force Systems Command, Wright-Patterson AFB, Ohio. Avionics Lab.

A REVIEW OF LIGHTNING PROBLEMS TO FLIGHT VEHICLES WITH SUGGESTED SOLUTIONS AND RELATED INTERFERENCE REJECTION TECHNIQUES

H. M. Bartman *In its* Lightning and Static Elec. Conf., Pt. 2 May 1969 p 3-17 refs (See N70-19027 07-02)
Avail: CFSTI

Flight vehicle lightning hazards problems and related RF interference are reviewed and past accomplishments and future requirements to reduce system vulnerability to lightning and static electricity are considered. The loss of communication and navigation information during natural disturbances, such as precipitation or atmospheric static, has necessitated the development of electronic interference rejection circuitry. A blanking approach using solid state components is described for control of RF interference from lightning discharges, electromagnetic pulses, and precipitation atmospheric static. R.B.

N70-19030# Federal Aviation Administration, Washington, D.C.

FAA LIGHTNING STRIKE EXPERIENCE ON AIRCRAFT AND DESIGN REQUIREMENTS FOR FUEL SYSTEMS

Robert J. Auburn *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 23-36 refs (See N70-19027 07-02)
Avail: CFSTI

An investigation is described to determine the causes of an airplane crash due to lightning ignition of flammable fuel vapors in wing tanks. A survey was conducted to determine the distribution of damage from lightning strikes over the surfaces of an aircraft. A research and development program is proposed for lightning protection of aircraft fuel systems. R.B.

N70-19031# Lightning and Transients Research Inst., Minneapolis, Minn. Lightning Research Oceanic Lab.

GENERAL LIGHTNING PROTECTION REVIEW SUMMARY

M. M. Newman *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 37-72 refs (See N70-19027 07-02)
Avail: CFSTI

Some typical flight data from aircraft struck by natural lightning, the lightning environment, and its laboratory reproduction are summarized. Design criteria and uniform standards of protection are proposed to reduce lightning vulnerability of flight vehicles. R.B.

N70-19032# Department of Industry, Ottawa (Ontario).

CANADIAN AIRCRAFT LIGHTNING PROTECTION RESEARCH

H. R. Shaver *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 73-80 (See N70-19027 07-02)
Avail: CFSTI

After structural damage and loss of facilities on an ASW aircraft, full-scale tests were conducted to improve lightning protection of the aircraft. Selected areas of the aircraft most vulnerable to lightning damage were tested from a number of different approach angles in proximity to a shipborne lightning facility. As a result of the tests, modifications and design changes were made to provide maximum protection for all aircraft in the Canadian civil and military service. R.B.

N70-19033# Air Registration Board, London (England).

BRITISH RESEARCHES AND PROTECTIVE RECOMMENDATIONS OF THE BRITISH AIR REGISTRATION BOARD

B. L. Perry *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 81-103 refs (See N70-19027 07-02)
Avail: CFSTI

A system for reporting details of lightning strikes to aircraft is summarized. From the airline reports accumulated, requirements and recommendations were formulated for protecting British civil aircraft against lightning damage. R.B.

N70-19034# British Aircraft Corp. (Operating) Ltd., Bristol (England).

LTRI: INDUSTRY COOPERATIVE PROGRAM RESEARCH ON THE CONCORDE SST

S. T. M. Reynolds and M. M. Newman (Lightning Transients Res. Inst.) *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 104-110 refs (See N70-19027 07-02)
Avail: CFSTI

Model studies with high-voltage discharges show that a high percentage of lightning strikes to typical SST aircraft may be expected to the pitot boom on the nose radome. Changes in antenna system design and materials required for maximum lightning protection are discussed. Tests show that hazards to navigation and communication equipment can be eliminated by installing shielding aluminum tubing. Studies are continuing on fuel system protection. R.B.

N70-19035# ARINC Research Corp., Huntsville, Ala.

AIRLINE COOPERATIVE PROGRAM RESEARCHES WITH THE LIGHTNING AND TRANSIENTS RESEARCH INSTITUTE ON AIRCRAFT LIGHTNING PROTECTION

D. S. Little and M. M. Newman (Lightning Transients Res. Inst.) *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 111-122 refs (See N70-19027 07-02)
Avail: CFSTI

Spark gap cartridges were analyzed for major stroke components of lightning discharge to the aircraft. The analytical data were used to set up artificial lightning generation facilities to duplicate the effects of natural lightning strokes on the arrester gaps. Model tests indicate the areas on an aircraft most vulnerable to natural lightning discharges. R.B.

N70-19036# Air Force Cambridge Research Labs., Bedford, Mass.

USAF FLIGHT LIGHTNING RESEARCH

Donald R. Fitzgerald *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 123-134 refs (See N70-19027 07-02)
Avail: CFSTI

Electrical phenomena in normal lightning strokes from an active or dissipating thunderstorm are compared with discharges from an electrical center in rain or snow shower clouds. Electrostatic field components in storms are compared with long term surface lightning stroke measurements to indicate ranges of values that may be encountered. It is considered probable that an aircraft entering a dissipating thunderstorm may trigger a lightning discharge. R.B.

N70-19037# Lightning and Transients Research Inst., Minneapolis, Minn.

TRIGGERED NATURAL LIGHTNING NEAR AN F-100 AIRCRAFT

James R. Stahmann *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 135-144 (See N70-19027 07-02)
Avail: CFSTI

Line-throwing rockets were fired from a research vessel toward charged clouds while remaining electrically connected to the vessel by a thin trailing stainless steel wire. A specially instrumented F-100 aircraft flew over the ship at the time the rocket was fired to intercept any natural lightning strokes triggered to the ship. Data on the lightning current and associated pressure waves,

streamers, and electric fields were collected on both the aircraft and the ship. Evaluation of the lightning protection of the aircraft show the possibility of induced streamering inside the canopy and possible canopy puncturing, which expose the pilot and observer to electric shock, and a direct stroke or streamering in the vent tube region on the vertical stabilizer may ignite the fuel-air efflux mixture, with possible flame propagation into the vent tube system.
R.B.

N70-19038# Lightning and Transients Research Inst., Minneapolis, Minn.
TRANSIENT PENETRATION EFFECTS ON AEROSPACE VEHICLE ELECTRONICS AND FUEL SYSTEMS
J. D. Robb *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 145-154 (See N70-19027 07-02)
Avail: CFSTI

The principal mechanisms by which transient surges from lightning discharges penetrate aircraft are reviewed. Techniques available for protection of metal-skinned flight vehicles are discussed and the hazards to aerospace vehicles using nonmetallic skins are evaluated.
R.B.

N70-19039# Stanford Research Inst., Menlo Park, Calif.
STATIC ELECTRICITY ON FLIGHT VEHICLES
J. E. Nanevicz and E. F. Vance *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 157-167 refs (See N70-19027 07-02)
Avail: CFSTI

The manner in which static electricity is generated in flight vehicles, the problems that can result from static electrification, and methods by which the problems can be minimized are discussed. Recommendations are made for evaluating modification of the electrical bonding of aircraft structures and in the use of plastic materials which might affect communication or navigation systems.
R.B.

N70-19040# Continental Air Lines, Inc., Los Angeles, Calif.
PRECIPITATION STATIC NOISE PROBLEMS ON OPERATIONAL AIRCRAFT
K. A. Moore *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 168-178 refs (See N70-19027 07-02)
Avail: CFSTI

A historical survey is given on development of devices to eliminate precipitation static on aircraft. Various operational problems are discussed and solutions are described to eliminate interference in radio communication systems.
R.B.

N70-19041# Princeton Univ., N.J.
THE ELECTROSTATIC CHARGING AND DISCHARGING PHENOMENA OF HELICOPTERS IN FLIGHT
G. Born, E. Sharkoff, E. J. Durbin, and R. Creed (ECOM, Ft. Monmouth, N.J.) *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 179-201 refs (See N70-19027 07-02)
Avail: CFSTI

The main parameters involved in the charging and discharging phenomena are the electrostatic properties of the helicopter, the atmospheric conductivity, and the charging and discharging processes. Safety limits for personnel and cargo are discussed and methods of preventing charges to build up on the helicopter are described.
R.B.

N70-19045# Fenwal, Inc., Ashland, Mass.
FLAME PROPAGATION THROUGH AIRCRAFT VENT SYSTEMS
G. J. Grabowski *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 254-261 (See N70-19027 07-02)
Avail: CFSTI

Tests were performed on a full scale mockup of a typical turbine aircraft vent system along with a theoretical analysis based upon current knowledge of combustion propagation. Fuel-air mixtures were obtained by heating JP-4 fuel to obtain a sufficient vapor pressure and adding air by the partial pressure method to achieve the correct ratio. Combustible mixtures were introduced into the vent system at the inboard end and the entire volume was purged until a reasonable homogeneous mixture existed. Results indicate vent system configuration was an important factor in flame propagation as well as wave reflections which occurred at high speeds.
Author

N70-19046# Atlantic Research Corp., Alexandria, Va.
AIRCRAFT FUEL VENT LINE SENSITIVITY TO LIGHTNING EFFECTS
M. Markels, Jr., J. M. Spurlock, J. D. Robb (Lightning Transients Res. Inst.), and J. R. Stahmann (Lightning Transients Res. Inst.) *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 262-294 refs (See N70-19027 07-02)
(Contracts FA-64-WA-4960; FA-64-WA-4955)
Avail: CFSTI

Lightning effects were investigated to determine the possible existence of ignition sources in a typical aircraft wing tank section. Flame propagation in the fuel vent system arising from lightning ignition is characterized. Associated hazards are discussed along with the effectiveness of remedial methods such as flame arresters and explosion suppression techniques. Feasible ignition source reduction measures are identified and demonstrated.
Author

N70-19047# Boeing Co., Seattle, Wash.
A METHOD FOR ESTABLISHING LIGHTNING RESISTANCE AND SKIN THICKNESS REQUIREMENTS FOR AIRCRAFT
R. O. Brick *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 295-317 refs (See N70-19027 07-02)
Avail: CFSTI

Tests for establishing skin thickness and lightning resistance requirements were performed. The lightning energy puncture threshold for aluminum with wide variations in current and time was established and hot spot ignition thresholds for typical electrical conductors were investigated. The lightning channel attachment in swept stroke zones were simulated to provide a basis from which test techniques were established for detail design studies and design verification tests. Skin damage caused by lightning in the direct and swept stroke zones is reviewed to provide a natural lightning damage record to which artificial lightning test results are compared.
J.M.C.

N70-19048# Fenwal, Inc., Ashland, Mass.
SURGE TANK PROTECTION SYSTEM
Frederick W. Newman AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 318-323 (See N70-19057 07-02)
Avail: CFSTI

The surge tank protection systems for the Boeing 707, 727, and 747 aircrafts are described. The system consists of a broadband radiation-type sensor located near the aircraft vent outlet, suppressors containing the inerting agent, and an indicator to signal when the system has been actuated. Diagrams are used to show the variations in the different installations.
J.M.C.

N70-19054# Boeing Co., Seattle, Wash.
ELECTRICAL BONDING OF ADVANCED AIRPLANE STRUCTURES
L. E. Short *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 425-441 refs (See N70-19027 07-02)
Avail: CFSTI

Interchangeable adhesive and electrical bonding are briefly reviewed. Requirements for an electrically continuous aircraft are discussed: (1) lightning protection, (2) electrical system current return paths, (3) electrostatic charge dissipation, (4) antenna performance, and (5) electromagnetic interference control. Conventional structure bonding is described, along with adhesive structural bonding enabling the use of composite materials.
J.A.M.

N70-19056# Lockheed-Georgia Co., Marietta.
A SURVEY OF AIRCRAFT STRUCTURAL BONDING AND GROUNDING FOR LIGHTNING AND STATIC
F. P. Holder *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 453-471 (See N70-19027 07-02)
Avail: CFSTI

Needed aircraft improvements in lightning protection are discussed for flying during adverse weather conditions and for using new materials for aircraft construction. Anodizing, weight vs. bonding, nonelectrical bonding, antistatic coatings, current return paths, nonmetals in compression, hardware configuring, spark and faying-surface sealing, static discharges, and resistance measurements are also cited. J.A.M.

N70-19057# Ministry of Defence, London (England).
PRACTICAL PROBLEMS ASSOCIATED WITH THE EARTHING OF AIRCRAFT
G. W. Cornish *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 472-481 (See N70-19027 07-02)
Avail: CFSTI

Aircraft grounding is discussed, providing operator protection and weapon system component protection, especially electrically initiated explosive devices during loading and unloading. An earth fault monitor was developed for use on all types of ground power units, and is undergoing service trials. To cover the interim period until all power units are fully protected, after the lifting of the negatives on ground power units, detailed instructions were issued and are herein summarized. Discharge paths created by the fitting of conducting tires were relied upon to dissipate static charges generated on the aircraft during flight and on the ground. J.A.M.

N70-19326*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLIGHT TEST OF A 40 FOOT NOMINAL DIAMETER DISK-GAP-BAND PARACHUTE DEPLOYED AT A MACH NUMBER OF 3.31 AND A DYNAMIC PRESSURE OF 10.6 POUNDS PER SQUARE FOOT
Clinton V. Eckstrom Washington Feb. 1970 46 p refs
(NASA-TM-X-1924; L-6693) Avail: CFSTI CSCL 01C

A 40-foot-nominal-diameter (12.2 meter) disk-gap-band parachute was flight tested as part of the NASA supersonic high altitude parachute experiment program. The test parachute (which included an experimental energy absorber in the attachment riser) was deployed from an instrumented payload by means of a deployment mortar when the payload was at a Mach number of 3.31 and a free-stream dynamic pressure of 10.6 pounds per square foot (508 newtons per square meter). The parachute deployed properly, the canopy inflating to a full-open condition at 1.03 seconds after mortar firing. The first full inflation of the canopy was immediately followed by a partial collapse with subsequent oscillations of the frontal area from about 30 to 75 percent of the full-open frontal area. After 1.07 seconds of operation, a large tear appeared in the cloth near the canopy apex. This tear was followed by two additional tears shortly thereafter. It was later determined that a section of the canopy cloth was severely weakened by the effects of aerodynamic heating. As a result of the damage to the disk area of the canopy, the parachute performance was significantly reduced; however, the parachute remained operationally intact throughout the flight test and the instrumented payload was recovered undamaged. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N70-18330*# Gulf General Atomic, San Diego, Calif.
STUDY OF RADIATION EFFECTS IN SILICON SOLAR CELLS Annual Report
J. A. Naber, B. C. Passenheim, and R. A. Berger 23 Jan. 1970 105 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952387; Proj. 6105)
(NASA-CR-107954; GA-9909) Avail: CFSTI CSCL 10B

Radiation effects in lithium diffused bulk silicon were studied to ascertain the nature of the defects responsible for the degradation in output of silicon devices (solar cells) irradiated by space radiation. Results of neutron activation analysis for lithium were inconclusive for lightly diffused silicon but generally indicate greater lithium concentrations in heavily diffused silicon than were inferred from resistivity measurements. No impurity dependence was observed for the degradation rate of samples irradiated with fission neutrons. Nearly all the neutron damage was annealed by first order kinetics between 300 and 380 K. An electron spin resonance investigation of the Si-G7 (divacancy) and Si-G8 (phosphorus vacancy) centers in electron irradiated lithium diffused silicon indicated exceptionally low production rates. The low divacancy production rate was verified by infrared absorption measurements. Author

N70-18339# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD FOR DETERMINING THE OPTIMUM PARAMETERS FOR THE CYCLE OF SIMPLE GAS TURBINE EQUIPMENT
D. D. Kalafati et al 25 Apr. 1969 17 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii Energ., (USSR), v. 10, no. 1, 1967 p 72-79
(AD-696544; FTD-HT-23-1231-68) Avail: CFSTI CSCL 10/2

Dimensionless formulas are derived for determining the optimum rise in pressure and temperature during the operating cycle of a simple gas turbine installation from the standpoint of minimum cost for mechanical or electrical output energy. It was found that the optimum degree of temperature rise decreases with an increase in the cost of the installation. Proportionality is assumed between the cost of the installation and the rated power of the turbine and compressor in determining the optimum technical and economic degree of pressure rise. Application of the proposed formulas is illustrated by calculating the optimum pressure rise for the GT-6-750 gas turbine installation. Author (TAB)

N70-18341# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICAL AND TECHNICAL PROBLEMS OF DIRECT CONVERSION OF CHEMICAL ENERGY INTO ELECTRICAL
N. S. Lidorenko et al 25 Apr. 1969 22 p Transl. into ENGLISH from Akad. Nauk SSSR. Izv. Energ. i Transp. (USSR), no. 4, 1968 p 3-12
(AD-696497; FTD-MT-24-39-69) Avail: CFSTI CSCL 10/2

An analysis is made of the basic power aspects of the problem of developing fuel cells. From a physical energy point of view the system of electrochemical generators (ECG) is examined on the basis of an analysis of three components-the ECG itself and the systems of accessories and automatic adjustment, the creation of which is combined with the solving of a number of specific problems. The most important of these problems are examined and the necessity of their overall solution is brought out. As an example of practical realization of these problems, data are cited for an electrochemical generator with polymeric hydrophobic electrodes. This generator has promise for application in ground transport equipment. An analysis is made of the technology of manufacture of electrodes, design of battery, and volt-ampere characteristics. Photographs are shown of a Soviet ECG with ion-exchange membranes and cermet electrodes. Author (TAB)

N70-18546# Advisory Group for Aerospace Research and Development, Paris (France).
SPACE POWER SYSTEMS, PART 1

Nov. 1969 336 p refs Lecture Ser. held at Brussels, 2 – 6 Oct. 1967 Sponsored by the Propulsion and Energetics Panel and the Consultant and Exchange Programme of AGARD
(AGARDograph-123-Pt-1) Avail: CFSTI

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2. SPACE POWER SYSTEMS G. C. Szego (IDA, Arlington, Va.) p 21 – 89 refs (See N70-18548 07-03)

3. NUCLEAR SPACE POWER SYSTEMS H. M. Diackamp p 93 – 302 refs (See N70-18549 07-22)

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N70-18548# Institute for Defense Analyses, Arlington, Va.
SPACE POWER SYSTEMS
George C. Szego *In* AGARD Space Power Systems, Pt. 1 Nov. 1969 p 21 – 89 refs (See N70-18546 07-03)
Avail: CFSTI

Power generation in space is discussed in terms of the basic subsystems: (1) an energy source or collector, (2) a conversion system (generally, to convert thermal into electrical energy) and, (3) a waste-heat rejection system. Heat rejection by means of radiation, and the design of radiators with the problems of meteorite damage are presented. Energy sources considered are: radioactive isotopes power supplies, nuclear power supplies, solar energy conversion systems, chemical rotating systems and static thermal energy conversion. Space power systems currently under development are charted, and the specific weights for a number of systems in the one to three kW range are plotted against cumulative on-time at full power. F.O.S.

N70-18550# Advisory Group for Aerospace Research and Development, Paris (France).
MECHANICAL HEAT ENGINES FOR SPACE POWER SYSTEMS
Eugene B. Zwick *In its* Space Power Systems, Pt. 1 Nov. 1969 p 305 – 348 refs (See N70-18546 07-03)
Avail: CFSTI

The heat engine concepts which are of significance for space applications are reviewed, and then examined from a thermodynamic viewpoint to establish basic cycle characteristics and the relative significance of various factors such as temperature and component efficiency of cycle performance. A few of these cycles are analyzed in terms of the problem of optimizing a power system for use with a space vehicle. Author

N70-18587*# Radio Corp. of America, Princeton, N.J. Astro Electronics Div.
STUDY TO DETERMINE AND IMPROVE DESIGN FOR LITHIUM DOPED SOLAR CELLS Quarterly Report, 1 Oct.-30 Dec. 1969
G. Brucker, T. Faith, J. Corra, and A. Holmes Siedle 10 Jan. 1970 51 p refs Prepared for JPL
(Contracts NAS7-100; JPL- 952555)
(NASA-CR-108080; AED-R-3528; QR-2) Avail: CFSTI CSCL 10B

A program to study and analyze the action of lithium in producing a recovery of radiation damage in bulk silicon and silicon solar cells is reported. Progress on solar cell experiments on the cold finger has included continuation of minority carrier lifetime vs temperature measurements on crucible grown cells, and anneals at 380 K. Lifetime vs temperature measurements after irradiation on Li-containing cells and non-lithium cells give recombination center energy levels at approximately E sub c-0.20eV, near the level of the A center. The recovery in an antimony-containing non-lithium cell is more than an order of magnitude larger than expected on the basis of published recovery rates. The recovery of antimony doped, lithium-containing cells is much lower than expected, suggesting some special interactions of lithium in at least one type of antimony doped silicon. Long-term stability tests on lithium-containing crucible grown cells and float zone and Lopex cells have continued. Crucible grown cells are stable for a wide range of densities in tests ranging from 110 days to 379 days after irradiation. Most float zone and Lopex cells suffer significant post recovery redegradation within approximately 100 days of irradiation. The time after irradiation at which redegradation sets in is longer for lightly Li-doped cells than for heavily Li-doped cells. Author

N70-18646*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC ATTITUDE AND SPIN CONTROL OF THE SMALL SCIENTIFIC SATELLITE S3-A
Thomas W. Flatley Washington Feb. 1970 17 p
(NASA-TN-D-5572; G-945) Avail: CFSTI CSCL 22B

The first spacecraft in the Small Scientific Satellite program is spin-stabilized with its spin axis nominally in the plane of its orbit. The orbit is eccentric and nearly equatorial, with perigee near-earth, and apogee altitute at approximately 4 earth-radii. The attitude and spin control system consists of two magnetic coils, a single-axis magnetometer, and associated electronics. One coil produces a magnetic moment along the spin axis for spin rate control. The magnetometer output is used (1) to enable the system when the magnitude of the ambient magnetic field is large enough for efficient use of the coils, and (2) for the logical operation of the spin control coil. In the design of a magnetic control system, a performance parameter consisting of the product (power) × (weight) × (on-time) is useful. Given the design constraints, this parameter is a function only of the reference field strength which enables the system. Optimization is achieved by selecting a reference field that minimizes this parameter. ... 00000

N70-18667*# Electric Storage Battery Co., Yardley, Pa. Carl F. Norberg Research Center. Exide Missile and Electronics Div.
HEAT STERILIZABLE IMPACT RESISTANT CELL DEVELOPMENT Quarterly Report, 1 Apr. – 30 Jun. 1969
A. M. Chreitzberg 23 Dec. 1969 76 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951296)
(NASA-CR-108082; QR-2) Avail: CFSTI CSCL 10C

Electrochemical studies are reported on silver – zinc cell cycle life and embrittlement. Cycle life is promoted by increased electrolyte concentration, and the presence of an absorber around the silver electrode. Sterilized cells give fewer cycles than unsterilized cells and fewer cycles are obtained after floating. Grid studies indicate that the strength of the amalgamated grid may be time dependent with grids becoming stronger with age. Five ampere-hour experimental cells failed by buckling at the plate strut positive material interface after repeated shock at 4,000 g. Seventy ampere-hour low impact prototype rechargeable primary cells were redesigned to increase plate tab to plate frame strength, negative erosion resistance, separator wet thickness, and the reliability of the case to cover epoxy seal. Twenty-five ampere-hour low impact cells in five designs were placed on 10-hour charge/2-hour discharge cycling routines. After 90 cycles in 4 months total wet life the most desired design factors chosen to increase capacity are: positive plate absorber > positive wrap > layers of membrane > a low density negative > platelock. Author

N70-18735# Army Electronics Command, Fort Monmouth, N.J.
ELECTRICAL PULSATIONS OF PROPANE-AIR DIRECT OXIDATION FUEL CELL
Peter Chutoransky, Jr. Oct. 1969 40 p refs
(AD-697126; ECOM-3183) Avail: CFSTI CSCL 10/2

Self-induced cycling of a propane-air direct oxidation fuel cell was observed. The fuel cell under investigation at 175C comprised a set of 5-5/16 inches x 5-5/16 inches AA-2 electrodes with a phosphoric acid filled TA-1 matrix. It was utilized as an integral portion of a submodule with water recovery for fuel

humidification. Air flow was at 1.5 x STOIC. Cycling, which was associated only with the anodic oxidation of propane, resulted in a rejuvenation and stabilization of the active electrode surfaces. It may be applicable as a means of increasing both performance and life of the ultra-simple direct oxidation fuel cell system presently under development at USAECOM. The inception of cycling, which was not of uniform periodicity, occurred under conditions related to propane concentration, apparent current density and degree of catalyst deactivation. A mechanistic interpretation of the cycling phenomena has been postulated; the coupling of reactions necessary for oscillatory behavior of this type is between a propane diffusion-adsorption step and platinum anodic oxidation-reduction. Author (TAB)

N70-18737*# Heliotek, Sylmar, Calif.
DEVELOPMENT OF LITHIUM DIFFUSED RADIATION RESISTANT SOLAR CELLS Quarterly Report
P. Payne and H. Somberg 15 Jan. 1970 41 p Prepared for JPL
(Contracts NAS7-100; JPL-952547)
(NASA-CR-108036; QR-2; Rept-6) Avail: CFSTI CSCL 10B

Boron diffusion studies were performed. A process was successfully developed using a BBr_3 source. Good output was achieved and stresses were negligible as demonstrated by diffusing 2x6 cm size blanks that were only 0.006 inch thick. Humidity exposure tests showed that the solderless Ti-Ag contact on P/N cells is not humidity resistant. Cells made using an eight-hour lithium diffusion at 325 C have had very good efficiencies. In fact, the distribution curve of the 60 cells with these diffusion parameters showed that these cells had the highest efficiencies of any fabricated to date. Author

N70-18954*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STEADY-STATE ANALYSIS OF A BRAYTON SPACE-POWER SYSTEM
John L. Klann Washington Feb. 1970 60 p refs
(NASA-TN-D-5673; E-5281) Avail: CFSTI CSCL 10A

An experimental Brayton space-power system was approximated in a digital computer study. Parametric and simulated fixed system operations to be conducted in the experimental system ground tests were examined. The study shows trends in system conversion efficiency for both design and off design operating conditions. The analysis is independent of operational limits. However, the present limitations of the existing hardware are discussed. With the design working-gas mixture of helium and xenon, and with temperatures at their design values, estimated levels of system conversion efficiency increased from about 0.14 to 2 kilowatts of output to about 0.24 in the 10- to 15-kilowatt range. Changes in conversion efficiency with off design turbine and compressor inlet temperatures were calculated. Each inlet temperature was individually varied while the other was maintained at its design value. Study of simulated radioisotope-power-system operations showed that bleeding working gas would be an effective means to maintain high system power outputs during the decay of a short-lived isotope. Author

N70-18956*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PERFORMANCE OF A HIGH-FREQUENCY WATTAGE-TO-VOLTAGE CONVERTER
James E. Vrancik Washington Feb. 1970 17 p refs
(NASA-TN-D-5674; E-5333) Avail: CFSTI CSCL 10A

A solid state wattage-to-dc-voltage converter, using a state of the art electronic analog multiplier, was designed and tested. The unit provides a dc output voltage proportional to the instantaneous product of two input signals. If the input signals represent the current and voltage in the circuit being tested, the output is proportional to the power of the circuit. The converter was found to have an accuracy of 0.2 percent of full scale over a frequency range from dc to 15 kHz for unity power factor. The accuracy decreased to 0.7 percent of full scale for power factors from 0 to 1 at 1 kHz. The slewing rate was 2V/microseconds. Author

N70-18977*# Texas Instruments, Inc., Attleboro, Mass. Research and Development Labs.
HEAT STERILIZABLE AND IMPACT RESISTANT Ni-Cd BATTERY DEVELOPMENT Quarterly Report, 1 Jul. - 30 Sep. 1969
P. V. Popat Sep. 1969 175 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951972)
(NASA-CR-108170; QR-9) Avail: CFSTI CSCL 10C

During this quarter, the research and development work on the electrochemistry of heat-sterilizable Ni-Cd cells was essentially completed. The problem of some capacity lowering of heat-sterilized cells was solved by improved assembly and measurement techniques, although the fundamental cause, if any, of some capacity lowering with sterilized prismatic cells has not yet been definitely established. Since the higher polarization of the sterilized cells is shown to be associated with changes in sterilized nickel electrode which does not interfere with satisfactory cell performance and since no hydrogen evolution was detected on cycling of sterilized cells, no further work on higher ECV of sterilized cells is indicated at present. Author

N70-19009*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANOLYTE STUDIES OF THE MAGNESIUM ELECTRODE IN MOLTEN MIXTURES OF LITHIUM CHLORIDE, POTASSIUM CHLORIDE, AND MAGNESIUM CHLORIDE
Lawrence H. Thaller Washington Feb. 1970 17 p refs
(NASA-TN-D-5657; E-5381) Avail: CFSTI CSCL 10C

A continuation of work on the Mg-LiCl-KCl-Cu2O-CuO thermal cell at 450 C is presented and is concerned with mass transport within the cell and its effect on performance. X-ray studies on discharged cells showed that magnesium ions and oxide ions do not rapidly diffuse away from the electrodes. This produced a $MgCl_2$ rich anolyte with a resulting decrease in cell voltage and an increase in the electrolyte freezing point. Quantitative studies of these effects were made using LiCl-KCl mixtures to which $MgCl_2$ was added. The emf and polarization of magnesium anodes in these electrolytes and the freezing points of the salt mixtures were studied. The poor operating characteristics of the magnesium anode under certain conditions could be explained from the results. Author

N70-19112# Thermo Electron Corp., Waltham, Mass.
THERMAL FLUX IN A RESEARCH PARAMETRIC CONVERTER
D. Lieb 30 Jun. 1969 29 p
(Contract AT(30-1)-3874)
(TEE-3874-6; TE-4086-32-70) Avail: CFSTI

The research guard-ring parametric converter was used to collect geometry-independent data on the performance of thermionic converters. Corrections to the surface temperature are derived, and excellent agreement between the dynamic sweep and static data is found. Results from heat balance tests indicate a preliminary value of 2.1 watts/A for the electron heating of the collector. The electron heating is proportional to the collector current over a wide range in the power-producing region. NSA

N70-19134*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TECHNICAL/SCIENTIFIC MEETING ON SPACE BATTERY SPECIFICATIONS, 1st SESSION Transcript of Proceedings
Oct. 1969 189 p Presented at Greenbelt, Md., 29 Oct. 1969
(NASA-TM-X-62656) Avail: CFSTI CSCL 10C

The interim model specifications for high reliability nickel-cadmium spacecraft cells are discussed. Problem areas

reviewed and topics discussed with respect to fabrication of the cells included plate quality, cell formation, negative to positive ratio, randomization of electrodes, non-woven separators, traceability of materials, and standard electrical tests. Specifications for sealed silver-cadmium cells were also considered. R.B.

N70-19187*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PERFORMANCE ANALYSIS OF A MEDIUM-POWER dc-dc CONVERTER
Arthur G. Birchenough and Francis Gourash Washington Feb. 1970 22 p refs
(NASA-TN-D-5643; E-5319) Avail: CFSTI CSCL 10A

The design and performance of an experimental dc-dc converter are described. The converter was rated for a power output of 1 kW, with a 150-percent overload rating, and it produced a 200-V, + or - 1-percent, dc output from an input of 56 V, +10 and -20 percent. Voltage regulation is accomplished by varying the duty cycle of the internal 7-kHz quasi-square-wave carrier. Integrated circuits in the control section, a proportional current drive system, and powdered metal cores (Ni-17Fe-2Mo) for the power transformer were some of the design features. The measured efficiency peaked at 92 percent and was 88 percent at 1 kW. The total component weight was 6 lb (2.7 kg). Author

N70-19190*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE OF A 2-15 KILOWATT BRAYTON POWER SYSTEM IN THE SPACE POWER FACILITY USING KRYPTON
David B. Fenn, James N. Deyo, Thomas J. Miller, and Richard W. Vernon Jan. 1970 35 p refs
(NASA-TM-X-52750) Avail: CFSTI CSCL 10A

A Brayton power system has been operated in a vacuum environment for 584 hours using krypton as the working gas. This investigation was the first operation of the complete Brayton power system. With the exception of the heat source and the heat sink (no radiator was used), the engine components represented flight-type hardware. The engine produced 9.2 kilowatts gross alternator power (7.8 kW estimated net engine power), a gross engine efficiency of 26 percent, and an estimated net engine efficiency of 22 percent at a turbine inlet temperature of 1400 F, a compressor discharge pressure of 44 psia, and a compressor inlet temperature of 80 F. Author

N70-19233*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STEADY-STATE ELECTRICAL PERFORMANCE OF A 400-HERTZ BRAYTON CYCLE TURBOALTERNATOR AND CONTROLS
Martin E. Valgora and Dennis A. Perz Washington Feb. 1970 28 p refs
(NASA-TN-D-5658; E-5332) Avail: CFSTI CSCL 10A

The steady-state electrical characteristics of a 9-kW, 400-Hz, Brayton cycle turboalternator, a voltage regulator - exciter combination, and a parasitic speed controller are presented. Areas investigated include the effects of the phase-controlled parasitic loads, voltage characteristics, and maximum output capabilities. The maximum output obtained from the turboalternator without exceeding design temperatures was 33 kVA near unity power factor. At 0.8 lagging power factor, the voltage-regulator exciter was capable of handling 24 kVA. Effects of the phase-controlled parasitic load included a maximum voltage deviation of over 2.5 percent, a maximum current distortion of 18.3 percent, and a maximum voltage distortion of 13.8 percent. Author

N70-19234*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTROMAGNETIC PERFORMANCE LIMITS OF A 1200-HERTZ LUNDELL ALTERNATOR FOR A BRAYTON-CYCLE POWER SYSTEM
Gary Bollenbacher and Heinz L. Wimmer 30 Dec. 1969 19 p refs
(NASA-TM-X-52742) Avail: CFSTI CSCL 10A

Overload tests were performed on a 10.7-kilowatt 1200-hertz Lundell alternator in order to determine its electromagnetic limitation on output power. The maximum output powers were 26 kilowatts at 0.85 power factor and 44 kilowatts and 1.0 power factor. Extrapolation from data available for lower powers indicates an 88-percent electromagnetic efficiency at 26.6 kilowatts and power factor of 1.0. Author

N70-19270*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND PERFORMANCE OF AN EXPERIMENTAL START PROGRAMMER FOR A SNAP-8 SPACE POWER SYSTEM
Robert J. Frye 16 Dec. 1969 14 p refs
(NASA-TM-X-52734) Avail: CFSTI CSCL 10A

A programmer to automate the SNAP-8 mercury-loop startup started the system from an initial condition in which all system pumps were powered by an auxiliary power source at reduced frequency and in which there was no mercury in the mercury pump. The final condition at the end of startup was self-sustaining operation of mercury loop and all pumps were powered by the turbine-alternator at rated frequency. The programmer was successfully used for 26 mercury-loop startups. Author

N70-19279# Army Electronics Command, Fort Monmouth, N.J.
NEW DESIGNS FOR ZINC-AIR BATTERIES
Howard R. Knapp Oct. 1969 25 p refs
(AD-697125; ECOM-3182) Avail: CFSTI CSCL 10/3

Since 1965, the U. S. Army Electronics Command has been actively engaged in research and development studies on zinc-air batteries for military applications. Information is presented on the design and construction features of mechanically rechargeable zinc-air batteries, with particular attention to the standard family of zinc-air batteries. This comprises 5 units ranging in capacity from 20 ampere-hours to 150 ampere-hours and achieves energy densities from 69 to 86 watthours per lb. The report provides information on battery design considerations for cell and battery components, electrical characteristics for load conditions varying from the 4-hour to the 50-hour rate and performance data over a temperature range from 0 degrees F to 125 degrees F to substantiate the selection of the present battery designs. Author (TAB)

N70-19319*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
SURVEYOR BATTERIES Final Engineering Report
A. J. Moses, W. M. Hetherington, D. Weinberger, A. A. Uchiyama, R. S. Bogner et al 15 Feb. 1970 157 p refs Prepared jointly by JPL and Hughes Aircraft Co., Culver City, Calif.
(Contract NAS7-100)
(NASA-CR-108207; JPL-TM-33-432) Avail: CFSTI CSCL 10C

The main battery design evolved over four distinct development phases that were designated: experimental, development, prototype and flight. Evolution of the final design, the test data relating to each model and the logic leading to the adoption of design improvements are described in this report. Problem areas and solutions are discussed as they relate to each of the phases. Unique features of this limited-cycle-life silver-zinc battery include high energy density (80 W-h/lb), hermetically-sealed design, a common gas manifold and a pressure transducer that permitted automatic charge termination. The battery electrical and physical characteristics are presented in detail for each model. Data are included from qualification, acceptance, solar-thermal-vacuum, and mission simulation testing and actual flight. Thermal and calorimetric measurements are presented with the lunar night survival data. The auxiliary battery was a primary silver-zinc battery. A brief design description is presented along with limited laboratory and flight test

data. Mission simulation and flight data, for both main and auxiliary battery models, indicate that design goals were either met or exceeded. Author

N70-19331*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.

SHELF AND CYCLE LIFE EVALUATION OF SILVER-ZINC CELLS

R. S. Bogner and A. A. Uchiyama 1 Jul. 1969 14 p refs
(Contract NAS7-100)
(NASA-CR-108133; JPL-TM-33-418) Avail: CFSTI CSCL 10C

Sterilized and control silver-zinc cells with various separator systems were given extended shelf and cycle life tests. Six of the twenty-three cells remained on the divalent silver-zinc voltage plateau for 12 to 20 mo at room ambient temperature. Only cells with a separator system of methacrylic acid graft on cross-linked polyethylene, that were not sterilized, delivered capacities comparable to their initial capacities. The cells were given several 100% depth-of-discharge cycles, and placed back in storage for 4.5 mo. After the second storage period, the cells were cycled on a daily basis (discharged to 1.00 V at 9.0 A and charged to 2.10 V at 2.0 A). The cells delivered 80 cycles without shorting. The data showed that the open-circuit voltage cannot be used to predict the capacity of a silver-zinc cell, but if the open-circuit voltage of a cell drops below 1.58 V, the cell is shorted and cannot be rejuvenated. Author

N70-19353*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF PUMP TRANSFER FREQUENCIES FROM AUXILIARY POWER TO ALTERNATOR POWER DURING STARTUP OF THE SNAP-8 SYSTEM

Ronald H. Soeder and Roy A. Lottig 13 Nov. 1969 55 p refs
(NASA-TM-X-52712) Avail: CFSTI CSCL 10A

System startup tests were conducted in order to evaluate SNAP-8 startup procedures. A critical parameter in startup is the frequency of the power supplied to the four system pumps by a battery-inverter unit during the initial part of the startup. During the startup testing, inverter frequencies ranging from 220 to 290 cycles per second were investigated. The lower frequency limit was found to be 270 cycles per second. This limit was based on the criteria that the mercury-pump pressure output must be sufficient to permit simple open-loop control of the mercury flow ramp. Author

N70-19637# Sundstrand Aviation-Rockford, Ill. Aviation Div.

ORGANIC WORKING FLUID THERMAL STABILITY INVESTIGATION. AEC RANKINE CYCLE TECHNOLOGY PROGRAM

R. E. Niggemann and L. A. Sibert [1969] 214 p
(Contract AT(04-3)-651)
(SAN-651-101) Avail: CFSTI

Working fluids to be used in an organic Rankine cycle power conversion system capable of long duration operation in a space environment were evaluated. A detailed investigation of the pyrolytic degradation of biphenyl and the eutectic mixture of biphenyl and phenyl ether (Downtherm A) was completed. Four hermetically sealed test loops were fabricated, charged with the working fluids, and operated for various lengths of time. Fluid samples were taken periodically and analyzed for physical and chemical properties. The results showed that at 700 F the degradation rates are so small that no appreciable concentration of high boiling compounds will occur in a system after many tens of thousands of hours and that the percentage degradation of the total loop inventory is a function of the ratio of the boiler inventory to total loop inventory. The projected degradation of the loop inventory to 10,000 hours was about 0.15% for the 700 F Dowtherm A and 0.16% for 700 F biphenyl. NSA

N70-19674# Sundstrand Aviation-Rockford, Ill.

ORGANIC RANKINE CYCLE PROGRAM Quarterly Progress Report, 1 Apr.-30 Jun. 1969

R. E. Niggemann 29 Aug. 1969 75 p refs
(Contract AT(04-3)-651)
(SAN-651-107; QPR-13) Avail: CFSTI

The investigation of the technology necessary to successfully develop an Organic Rankine Cycle power conversion system capable of long duration operation in a space environment was continued. The specific working fluids being evaluated are biphenyl and the eutectic mixture of biphenyl and biphenyl ether. The four main areas of investigation include: the pyrolytic degradation of the working fluids; the performance and stability of bearings operating in the eutectic mixture; evaluation of small high speed condensate pumps operating at high suction specific speeds with the eutectic mixture; and the heat transfer, performance characteristics, and stability of organic working fluid boilers. The working fluid investigation indicated that both biphenyl and the eutectic mixture are about equally stable, exhibiting only 0.15% degradation of the loop inventory in 10,000 hrs at 700 F. Hydrodynamic bearings of several types operated satisfactorily with the eutectic while the only roller bearing tested seriously degraded after 25 hours. Dissert. Abstr.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N70-18354*# Hawaii Univ., Honolulu. Dept. of Botany.

ROLE OF GRAVITATIONAL STRESS IN LAND PLANT EVOLUTION: THE GRAVITATIONAL FACTOR IN LIGNIFICATION Semiannual Report

S. M. Siegel Dec. 1969 28 p *Its* Hawaii Botan. Sci. Paper No. 16
(Grant NGR-12-001-053)
(NASA-CR-107949) Avail: CFSTI CSCL 06C

The lignification in plants under hypogravity and hypergravity conditions was studied in herbaceous seedlings. An uncoupling of lignin from growth, and lignin increase with g were shown by the simulated gravity conditions. The relationship of lignin content to plant size is discussed. F.O.S.

N70-18436*# George Washington Univ., Washington, D.C. Medical Center.

BIOMEDICAL APPLICATION OF AEROSPACE TECHNOLOGY FOR NASA Quarterly Report, 1 Jun.–31 Aug. 1969

31 Aug. 1969 108 p
(Contract NSR-09-010-057)
(NASA-CR-107797) Avail: CFSTI CSCL 06E

The evolvement of the BATeam (Biomedical Applications Teams) program, its methodology and objectives, and the management of activities of different elements participating in the program are described. Significant points resulting from a review and analysis of BATeam data and information as well as from the Biological Sciences Communication Project (BSCP) efforts are summarized. Conclusions deduced by BSCP from BATeam reports and BSCP activities are cited with recommendations designed to optimize the advantageous developments and to correct negative trends. In addition, the teams are analyzed and the data submitted by them are related to the program objectives and team tasks. Author

N70-18452# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MONOGRAPHS ON THE PHYSIOLOGY AND PATHOLOGY OF MAN AND ANIMALS UNDER HIGH-MOUNTAIN CONDITIONS

M. A. Aliev et al 9 Dec. 1968 174 p refs Transl. into

ENGLISH from Ocherki po Fiziol. i Zhivotn. Usloviyakh Vysokogorya, (Leningrad), 1967 p 1-158
(AD-696169; FTD-MT-24-262-68) Avail: CFSTI CSCL 6/19

The monograph treats problems of acclimatization and adaptation to alpine environments, experimental considerations of such problems and illnesses encountered under such conditions, and pharmacological approaches to alpine acclimatization.

Author (TAB)

N70-18495# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPACE INVESTIGATIONS AND BIOLOGICAL SCIENCES
O. G. Gazenko 15 May 1969 21 p refs Transl. into ENGLISH from Konf. Organ. Obedinennykh Natsii Po Issledovanniyu i Ispolz. Kosmich. Prostranstva v Mirnykh Tselyakh (Vienna), 1968 p 1-10
(AD-696487; FTD-MT-24-98-69) Avail: CFSTI CSCL 6/3

A very general introductory account is given of the importance of space biology and its relationship to present day needs on earth.

Author (TAB)

N70-18498*# State Univ. of New York at Buffalo. Center for Theoretical Biology.
SUMMER COLLOQUIUM IN THEORETICAL BIOLOGY
J. F. Danielli 16 Dec. 1969 62 p refs Conf. Presented at Ft. Collins, Colo., 1969
(NASA-CR-107865) Avail: CFSTI CSCL 06C

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1. ORGANIZATION OF THE COLLOQUIUM p 1-3
2. WORKING PARTIES: SUBJECT, FACULTY, PARTICIPANTS, REPORTS p 4-8
3. TIME DEPENDENT VARIATION IN CELLS B. Goodwin (Sussex Univ., Brighton, England.) p 9-13 refs (See N70-18499 07-04)
4. INTRACELLULAR RELATIONSHIPS AND CELL THEORY J. F. Danielli, E. A. Pollard, and Paul Scheie (Pa. State Univ.) p 14-20 (See N70-18500 07-04)
5. PATTERN GENERATION AND MORPHOGENESIS R. Rosen and M. Ycas (Upstate Med. Center, Syracuse, N.Y.) p 21-31 refs (See N70-18501 07-04)
6. SELF-REPRODUCING AUTOMATA, RELATIONAL SYSTEMS AND CELL 1 THEORY H. Pattee (Stanford Univ., Calif.), L. Bianchi, and J. Hamann p 32-34 (See N70-18502 07-04)
7. INFORMATION PROCESSING BY CELL ASSEMBLIES K. N. Leibovic p 35-39 (See N70-18503 07-04)
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N70-18499*# State Univ. of New York at Buffalo. Center for Theoretical Biology.
TIME DEPENDENT VARIATION IN CELLS
B. Goodwin (Sussex Univ., England) *In its* Summer Colloq. in Theoret. Biol. 16 Dec. 1969 p 9-13 refs (See N70-18498 07-04)
Avail: CFSTI CSCL 06C

Dynamic characterization and stability of self-reproductive systems are reviewed. Metabolic networks simulated by switching automata nearly always showed cyclic behavior in their steady states; this analysis was extended to show that metabolic networks with macromolecular control elements have low connectivity and will show limit cycle behavior in the steady state. Dynamical consequences of certain efficiency criteria applied to chemical networks were studied, producing evidence that optimal behavior of the network and product yield occur when the variables oscillate. A mathematical model of oscillating biochemical networks with stable temporal organization was also investigated, along with a problem in developmental pattern formation. J.A.M.

N70-18500*# State Univ. of New York at Buffalo. Center for Theoretical Biology.
INTRACELLULAR RELATIONSHIPS AND CELL THEORY
J. F. Danielli, E. A. Pollard (Pa. State Univ.), and Paul Scheie (Pa. State Univ.) *In its* Summer Colloq. in Theoret. Biol. 16 Dec. 1969 p 14-20 (See N70-18498 07-04)
Avail: CFSTI CSCL 06C

Procedural methods of intracellular investigations are proposed. Existence limits of terrestrial cells and cells from Mars and Venus are discussed. Isoprene biochemistry related to hydrocarbon phase cells was considered, as well as the possibility of constructing macromolecules and membranes from complex polyisoprenes. Genetic systems of E. coli were briefly cited. Alternative approach to cell synthesis, control of cell function by steroids, E. coli inadequacy as model for understanding steroid response in mammalian systems, estrogen action, and minimal cell membranes are also mentioned. A temperature limit study of DNA genetic systems is recommended. J.A.M.

N70-18501*# State Univ. of New York at Buffalo. Center for Theoretical Biology.
PATTERN GENERATION AND MORPHOGENESIS
R. Rosen and M. Ycas (Upstate Med. Center, Syracuse, N.Y.) *In its* Summer Colloq. in Theoret. Biol. 16 Dec. 1969 p 21-31 refs (See N70-18498 07-04)
Avail: CFSTI CSCL 06C

Work on protein tertiary structure, virus assembly, and cell sorting is proposed. A hypothesis stating that motility and differential adhesion are sufficient to account for cell sorting is examined, along with its implications for morphogenesis of real biological patterns. The system is modeled on a two-dimensional grid, and neighboring configurations are introduced. J.A.M.

N70-18502*# State Univ. of New York at Buffalo. Center for Theoretical Biology.
SELF-REPRODUCING AUTOMATA, RELATIONAL SYSTEMS AND CELL 1 THEORY
H. Pattee (Stanford Univ., Calif.), L. Bianchi, and J. Hamann *In its* Summer Colloq. in Theoret. Biol. 16 Dec. 1969 p 32-34 (See N70-18498 07-04)
Avail: CFSTI CSCL 06C

Logical and physical bases for the origin and propagation of hierarchical systems are summarized. A general definition of hierarchy was developed, along with specific concepts of hierarchical control and control continuity. A preliminary model for the autonomous emergence of life was derived. Discussions on probabilistic extremization method, stochastic vs. deterministic descriptions, biological information, chemical reaction stability, macromolecule properties, and computer simulated eco-systems are included. J.A.M.

N70-18503*# State Univ. of New York at Buffalo. Center for Theoretical Biology.
INFORMATION PROCESSING BY CELL ASSEMBLIES
K. N. Leibovic *In its* Summer Colloq. in Theoret. Biol. 16 Dec. 1969 p 35-39 (See N70-18498 07-04)
Avail: CFSTI CSCL 06C

Problems in visual adaption and binocular space perception are presented. In visual adaption, the relationships of psychophysical data to the responses of single cells and cell assemblies, primarily in the retina, are considered including a neural model, a quantitative comparison of stimulus parameters and corresponding responses, and empirical curve fitting. In the binocular space perception, relationships in psychophysics, eye geometry, and data processing are given containing a model relating behavioral data to neural hypothesis, preliminary calculations indicating different predictions of the model from Luneberg theory, and modification of Luneberg theory. J.A.M.

N70-18529*# Oakland Univ., Rochester, Mich. School of Engineering.
MUSCULAR COORDINATION AND MULTI-DEGREE OF FREEDOM CONTROL SYSTEMS
J. C. Hill *In its* Biosystems Eng. Res. 30 Oct. 1969 p 4–44 refs (See N70-18528 07-05)
Avail: CFSTI CSCL 06P

Work on a physiological computer model for the stick man concentrated on digital simulation of expressions for muscular kinetic and potential energies and the differentiation operations required to obtain the pertinent equations of motion. Preliminary results reported cover: (1) the derivation of full nonlinear equations of motion for a seven-element stick man with the use of a digital symbolic processing language; (2) the small angle approximations that lead to a linearized model suitable for small deviations from equilibrium; (3) the digital simulation of above small angle model; and (4) the experimentation with an idealized form of control law, with each joint torqued proportional to the joint angular deflection and proportional to the joint angular rate. G.G.

N70-18530*# Oakland Univ., Rochester, Mich. School of Engineering.
NASA BIOSYSTEMS: BIO-OPTICS
R. H. Edgerton *In its* Biosystems Eng. Res. 30 Oct. 1969 p 45–60 (See N70-18528 07-05)
Avail: CFSTI CSCL 06P

Considered is the application of liquid crystals to control problems in bio-optical dynamic tracking problems where the human physiological eye focus control is not adequate and augmentation of visual accommodation is required. The technique of altering the index of refraction is used to evaluate rapid response possibilities of liquid shear type crystals. Theoretical results are obtained for a crystal control problem that uses ellipsoidal particles representing long molecules in a simple shear field. The dielectric constant of a suspension in which the ellipsoids are in motion is obtained as a function of axle ratio. Physiological experiments to determine the transparency of excised rabbit corneas show that the ratio of the intensity transmitted to scattered light is approximately 10 to 1. G.G.

N70-18533*# Oakland Univ., Rochester, Mich. School of Engineering.
A MODEL OF THE HUMAN POSTURAL CONTROL SYSTEM
J. C. Hill *In its* Biosystems Eng. Res. 30 Oct. 1969 12 p refs Presented at the IEEE Systems and Cybernetics Conf., Philadelphia, 22–24 Oct. 1969 (See N70-18528 07-05)
Avail: CFSTI CSCL 06P

A nine degree of freedom pitch axis model of the human postural control system is proposed. Expressions for the kinetic and potential energies of the system are derived. The trunk, thigh, shank, foot, upper arm, forearm, and head are each modeled by a lumped mass at the element center of mass and an associated rotational inertia. Author

N70-18558# School of Aerospace Medicine, Brooks AFB, Tex.
DISCOVERY OF HEARING LOSS IN A CEBUS CAPUCINUS MONKEY BY A SHOCK-AVOIDANCE TECHNIQUE Final Report, Jun. 1968-Feb. 1969
Daniel E. Dreher and Vernon C. Bragg Oct. 1969 12 p refs (AD-697384; SAM-TR-69-57) Avail: CFSTI CSCL 6/5

A hearing loss brought about by infection after middle ear surgery in a Cebus capucinus monkey was detected on an audiogram elicited by a shock-avoidance technique. Stable prepathology thresholds to five pure-tone frequencies had been established previously, and the course of infection and recovery after treatment was clearly demonstrated. This threshold measurement technic proved valuable in detecting the results of middle ear surgery and in describing changes in hearing during ear pathology. Author (TAB)

N70-18592*# California Univ., Los Angeles. Brain Research Inst.
EYE MOVEMENT DURING SLEEP AND WAKING IN INFANT MONKEYS (MACACA MULATTA) DEPRIVED OF PATTERNED VISION
Ralph J. Berger and Gilbert W. Meier [1970] 30 p refs
(Grant NsG-502; Contract AF 49(638)-1387; Grants NIH NB-02501; NIH FR-3)
(NASA-CR-108091) Avail: CFSTI CSCL 06C

Five newborn rhesus monkeys deprived of patterned vision and 4 normal sighted controls were reared until 18 months of age. There was a significant decrease in frequency of rapid eye movement (REM) with age in both groups. Frequency of REM tended to be lower in experimental monkeys than in controls. Asymmetries in velocity of waking horizontal eye movement were evident in experimental monkeys, and the velocity of REMs was less in pattern deprived monkeys than in controls. Nonsequential interval histograms between REMs at 18 months of age differed significantly from a random exponential distribution in both groups. Pattern deprived monkeys had significantly fewer short intervals between REMs than controls. Author

N70-18642# Army Medical Research Lab., Fort Knox, Ky.
PRACTICE EFFECTS AND SIGNAL DETECTION INDICES IN AN AUDITORY VIGILANCE TASK Progress Report
Jimmy L. Hatfield and David R. Soderquist 30 Jun. 1969 15 p refs
(AD-696418; USAMRL-827) Avail: CFSTI CSCL 5/10

Performance of subjects was investigated in 90-minute vigilance sessions. Trends in performance over and within sessions were examined in terms of three dependent measures: (a) correct detections, (b) errors of commission, and (c) theory of signal detectability (TSD). Author (TAB)

N70-18660# Ballistic Research Labs., Aberdeen Proving Ground, Md.
PROBABILITY ANALYSIS OF OCULAR DAMAGE DUE TO LASER RADIATION THROUGH THE ATMOSPHERE
Paul H. Deitz Sep. 1969 40 p refs
(AD-697151; BRL-MR-2012) Avail: CFSTI CSCL 6/5

A mathematical model is developed which predicts the probability of ocular damage occurring to personnel illuminated by a pulsed laser beam as a function of the appropriate optical and atmospheric parameters. The evaluation includes terms for the laser output energy and divergence, and atmospheric parameters of attenuation and scintillation. Sample computations are shown, and a safety nomograph is developed to facilitate the eye hazard analysis. Author (TAB)

N70-18661# School of Aerospace Medicine, Brooks AFB, Tex.
A SHOCK-AVOIDANCE TECHNIQUE FOR DETERMINING AUDIOLOGIC THRESHOLDS IN THE CEBUS MONKEY Final Report, Nov. 1967-Dec. 1968
Vernon C. Bragg and Daniel D. Dreher Oct. 1969 16 p refs
(AD-697385; SAM-TR-69-58) Avail: CFSTI CSCL 6/16

Audiologic thresholds were determined in fourteen white-throated Cebus capucinus monkeys using a shock-avoidance method. Results indicated that this is an effective technique for use with this species of monkey. Stable and consistent thresholds within subjects were found, but a wide range existed between animals. Author (TAB)

N70-18671# School of Aerospace Medicine, Brooks AFB, Tex.
NOMOGRAMS CORRELATING DOSE OF MMH WITH BLOOD LEVELS Final Report, May-Nov. 1967
Edwin B. Smith and Dale A. Clark Sep. 1969 16 p refs
(AD-697374; SAM-TR-69-12) Avail: CFSTI CSCL 6/20

Nomograms were developed to show the interrelationship of time and dose to methemoglobinemia or plasma monomethyl hydrazine (MMH) concentration as observed during the first 2 hours after application of MMH to the chest of anesthetized male dogs. Limitations of the nomograms are discussed in respect to

range and accuracy. It is emphasized that the nomograms were compiled from responses of anesthetized dogs. These nomograms could be used to estimate the severity of human exposure only in conjunction with other known MMH intoxication symptoms. In the absence of dose-response data from humans, however, the nomograms are considered the best available data by which to evaluate accidental exposure by skin contact with MMH. Author (TAB)

N70-18673# School of Aerospace Medicine, Brooks AFB, Tex.
FABRICATION OF LITHIUM CHLORIDE-BALSA WOOD ELECTRODES FOR ELECTROCARDIOGRAPHIC MONITORING Final Report, Jan. 1967-Oct. 1968
Makley G. Salter Aug. 1969 12 p refs
(AD-697380; SAM-TR-69-51) Avail: CFSTI CSCL 6/12

An ECG electrode belt of balsa wood impregnated with lithium chloride was developed for possible use in long-term space missions. The method used to impregnate the electrodes is described, and a step-by-step procedure is given for the assemblage of the belt. The equipment can be adapted for use in emergency medical monitoring and in intensive care units. Author (TAB)

N70-18678# Johns Hopkins Univ., Baltimore, Md. School of Medicine.
RESEARCH AND DEVELOPMENT OF FUNDAMENTAL PERFORMANCE INFORMATION RELEVANT TO THE BEHAVIORAL EFFECTS OF LOW LEVEL MICROWAVE EXPOSURE Annual Summary Report, 31 Oct. 1968-31 Oct. 1969
Joseph F. Dardano Oct. 1969 18 p refs
(Contract DADA17-69-C-9076)
(AD-697161; Rept-4) Avail: CFSTI CSCL 6/18

The report covers the first year of a research program designed to provide information on the behavioral effects of low-level microwave radiation. A laboratory facility was established for an experimental analysis of the performance of primates exposed to a specified microwave field and experimental methods have been developed which will permit the assessment of changes in complex behavior resulting from acute and chronic exposure to a low-level microwave field of defined frequencies. In addition, methods are being developed for assessing biochemical effects of microwave exposure under conditions related to such performance changes. Author (TAB)

N70-18684*# Michigan Univ., Ann Arbor. Dept. of Psychology.
A RESPONSE BIAS EXPLANATION OF CONSERVATIVE HUMAN INFERENCE
Wesley Michael DuCharme Dec. 1969 58 p refs
(Grant NGR-23-005-171)
(NASA-CR-108084; Rept-08901-1-T; TR-19) Avail: CFSTI CSCL 05J

Conservative human inference was attributed to misperception or misaggregation of data. Subjects revised odds estimates with two normal distribution data generators being sampled. An analysis of special sequences and a plot of revised odds against theoretical odds showed a bias in subjects' response functions. With different levels of prior odds, subjects shifted their response functions, so that, the optimal range centered around the set prior odds. The biased functions remained invariate over changes in data generator familiarity and diagnosticity. Subjects were biased over either cumulative evidence impact or the number system, but within their optimal range they neither misaggregated nor misperceived data. Author

N70-18699# School of Aerospace Medicine, Brooks AFB, Tex.
MICROBIOLOGIC EVALUATION OF FROZEN FOIL PACK MEAL COMPONENTS Final Report, Aug. 1967-Jan. 1968
Raymond A. Madson, Joseph T. Cordaro, Charles Eller, and Dennis T. Nelson Aug. 1969 18 p refs
(AD-697378; SAM-TR-69-47) Avail: CFSTI CSCL 6/8

Microbiologic analyses were performed on foil pack meal components which had been precooked and frozen. Food lots were compared on the basis of conformance and nonconformance of total bacterial plate counts and of total coliform counts to the current Military Specifications (MS). The proportion of meat lots rejected at Francis E. Warren AFB was higher than at the School of Aerospace Medicine ($P < .05$). At the .05 level, no difference was detected in the proportion of vegetable lots rejected by both laboratories. Most of the total plate counts and total coliform counts were much lower than the maximum allowed by the MS. Consequently, the recommendation will be made to change the bacterial requirements: to total plate count not greater than 30,000 per gram, instead of 100,000 per gram; and to total coliform count of 10 per gram, instead of 100 per gram. Various microbiologic methods recommended by other food technology groups were performed for the recovery of Salmonellae and coagulase-positive staphylococci. Author (TAB)

N70-18716# Tufts Univ., Boston, Mass. Dept. of Medicine.
STUDIES WITH ION-EXCHANGE CALCIUM ELECTRODES IN BIOLOGICAL FLUIDS: SOME APPLICATIONS IN BIOMEDICAL RESEARCH AND CLINICAL MEDICINE
Edward W. Moore *In* NBS Ion-Selective Electrodes Nov. 1969 p 215–285 refs (See N70-18709 07-06)
(Grants PHS-AM-07417; PHS-AM-10307; PHS-AM-13357; PHS-AM-05424)
Avail: SOD $3.50

Studies with ion-exchange calcium electrodes are summarized and an attempt is made to develop a reasonably coherent thesis concerning some of the complex physicochemical factors governing serum calcium in man. From data obtained in various aqueous salt solutions, in sera, and in ultrafiltrates, models were developed for the state of serum calcium in normals, in patients with cirrhosis, and in the hypercalcemia of malignancy. The binding of calcium to the serum proteins was found to obey the mass-law equation and a dissection of the relative contributions in albumin and globulin was achieved by a simple regression analysis. Author

N70-18717# American Univ., Beirut (Lebanon). Dept. of Physiology.
ION-SELECTIVE ELECTRODES IN BIOMEDICAL RESEARCH
Raja N. Khuri *In* NBS Ion-Selective Electrodes Nov. 1969 p 287–312 refs (See N70-18709 07-06)
Avail: SOD $3.50

Potentiometric measurements and electrodes for biological applications are discussed. Measurements of ion activities in biologic media both in vitro and in vivo are described, the latter including both extracellular and intracellular analyses. The design and characteristics are given for three glass electrodes for work with hydrogen (pH), sodium, and potassium ions, respectively. Metallic electrodes, the quinhydrone electrode involving reversible oxidation-reduction, and the new class of ion-exchange membrane electrodes with solid state or liquid–liquid membranes are also considered. N.E.N.

N70-18767*# Mississippi State Univ., State College. Microbiology Dept.
CHARACTERIZATION STUDIES ON AN EXTRACELLULAR HETEROPOLYSACCHARIDE PRODUCED BY ANABAENA FLOS-AQUAE A-37
Edith Boyanton Davis (Ph.D. Thesis) Jan. 1970 112 p refs
(Grant NGR-25-001-004)
(NASA-CR-107839) Avail: CFSTI CSCL 06M

The extracellular polysaccharide produced by the blue-green alga Anabaena flos-aqua A-37 was analyzed by various methods to determine the nature of the polymer. Chromatographic methods identified the components of the polysaccharide as uronic acid, glucose, galactose, mannose, arabinose, xylose, fucose, ribose, and rhamnose; it was not possible to demonstrate the presence of neutral polysaccharides. G.G.

N70-18772# School of Aerospace Medicine, Brooks AFB, Tex.
AN IMPROVED HISTOLOGIC TECHNIQUE FOR STUDYING PRIMATE RETINA Final Report, Jun. 1968-May 1969
Philip S. Coogan and Fred Morris Sep. 1969 19 p
(AD-697381; SAM-TR-69-53) Avail: CFSTI CSCL 6/3

The histologic technique for preparing primate retina described in this report includes intravascular perfusion with a glutaraldehyde-paraformaldehyde mixture followed by osmium postfixation and Epon embedding. The technique routinely yields histologic preparations of good quality which are suitable for both light and electron microscopy. The Paragon stain used for light microscopy gave excellent differentiation of receptor cell parts and made it easy to distinguish normal from degenerating receptor cells. The intravascular perfusion of fixative prevented artifactual rectinal detachment, thus making this technique useful in studying retinal photic injury. Author (TAB)

N70-18795# Army Engineer Reactors Group, Ft. Belvoir, Va. Engineering Div.
ERGDOSE: A UNIVAC 1108 COMPUTER CODE TO CALCULATE PREDICTED DOSES FROM THE DESIGN BASIS ACCIDENT Final Report
Lester K. Aldrich, II, Charles E. Meyer, and Charles A. Myers 15 May 1969 41 p refs
(AD-697140; ED-6913) Avail: CFSTI CSCL 6/18

A major concern in the siting of a nuclear power plant is the effect of released radioactivity in the case of a design accident. Such a situation implies release of all fission products from the fuel matrix, and further leakage of those highly radioactive products from the vapor container along with the associated high-pressure steam. Once in the atmosphere, the fission products can be spread by the prevailing wind, and in this way, are likely to be inhaled by nearby inhabitants. Of the many products of nuclear fission, iodine, because of its concentration by the thyroid after ingestion into the body, represents the greatest biological hazard. A computer code, ERGDOSSE (Engineer Reactors Group DOSE Calculation) was written specifically to calculate the resultant ingested dose due to five isotopes of iodine at any time after the initiation of a design basis accident, and at any distance from the site of that accident. Author (TAB)

N70-18840 Wisconsin Univ., Madison.
QUANTITATIVE MODELS FOR HUMAN MOTIONS
Appu Palpu Kattan (Ph.D. Thesis) 1968 421 p
Avail: Univ. Microfilms: HC $19.15/Microfilm $5.40 Order No. 69-939

A unified approach to modelling human motion was developed. Identification of the response and independent variables was accomplished by means of an interdisciplinary survey. It resulted in the identification of 47 broad classes of independent variables and 11 broad classes of response variables and possible relations among them. The survey also led to the following conclusions: there is no unified approach to the study of human motion; the interactions among the independent variables are neglected in most studies; theoretical findings are not satisfactorily incorporated into practice; theoretical research lags experimental research; task variables among independent variables and temporal variables among response variables are studied most. Four response variables, reaction time, movement time, manipulation time, and motion path length, and 3 independent variables, stimulus information, movement information, and manipulation information are considered. Dissert. Abstr.

N70-18899# Texas Univ., Galveston. Medical Branch.
ELECTRON MICROSCOPIC STUDIES ON ANIMALS EXPOSED TO DIFFERENTIAL POTENTIAL SPACECRAFT ENVIRONMENTS Final Report, Jun. 1966-Sep. 1968
Richard B. Marshall, Daniel K. Roberts, Robert A. Turner, and Donald L. Gordon Aug. 1969 43 p refs
(Contract AF 41(609)-3150)
(AD-697375; SAM-TR-69-34) Avail: CFSTI CSCL 6/19

Groups of male rats were exposed to 100% oxygen at 380 mm. Hg pressure and to normal atmosphere at ground level. They were sacrificed at 2-week intervals throughout the exposure period. Biochemical studies showed a pituitary adrenal response after 1 week of exposure to 100% oxygen at 380 mm. Hg pressure, returning toward control level after 3 weeks. Noise stress experienced by some of the animals after 7 weeks of exposure to 100% oxygen resulted in a marked rise in plasma corticoids. In animals exposed for 1 week, no alteration of ultrastructure was seen in the pituitary and only minimal alteration was seen in the adrenals. Pituitaries of the experimental rats exposed for 5 weeks showed no ultrastructural evidence of change. Adrenal cortical cells from these animals showed an increase in dense lipid and mitochondrial change at 1, 3, and 5 weeks of exposure. Pituitaries of rats stressed after 7 weeks of exposure showed ultrastructural evidence of secretory release from increased number of adrenal corticotrophic cells with a cytologic change in the fasciculata cells of the adrenal glands. Author (TAB)

N70-18912*# California Univ., Los Angeles. Brain Research Inst.
UCLA 1969 SUMMER INSTITUTE IN SPACE BIOLOGY Final Report
Jan. 1970 210 p refs Presented at Los Angeles, 28 Jul.–29 Aug. 1969
(Contract NSR-05-007-069)
(NASA-CR-108120) Avail: CFSTI CSCL 06C

The program offered during the summer institute centered on the following three projects: (1) to design a biological experiment for a moon laboratory that includes engineering and electronic aspects; (2) to formulate desirable crew characteristics, including personality ones, and to devise tests to evaluate these characteristics; and (3) to search for intelligent life in the Universe, and to devise a transmission method for a possible communicative message. Emphasis was placed on basic biological systems in regard to problems of acquisition of biological signals from difficult environments and their analysis by modern digital computing techniques. G.G.

N70-18933 Wisconsin Univ., Madison.
REAL-TIME HYBRID-COMPUTER FEEDBACK ANALYSIS OF ACOUSTIC IMPEDANCE AND HEARING
Rolf Gunther Schuenzel (Ph.D. Thesis) 1968 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-993

The research encompassed three preliminary exploratory studies dealing with middle ear impedance variation due to facial muscle contractions, taste bud stimulation, and metabolic oxygen and carbon dioxide imbalance, and research on closed loop control and automation of impedance measurement. The major research involved (1) the development of a hybrid computer system for the automated measurement and control of middle ear impedance and (2) application of this system to studies of dynamic response of the intra-aural reflex by means of feedback experimentation. It is concluded that the methods developed may in time be adapted as a new method of diagnosis of certain middle ear pathologies. Overall, the main conclusion is that the ear operates as a dynamic feedback system in controlling every aspect of sensory input by dynamic response of the middle ear. Dissert. Abstr.

N70-18944 California Univ., Berkeley.
KINETICS OF A DENSE CULTURE FERMENTATION
Lyman Dale Sortland (Ph.D. Thesis) 1968 171 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-10387

A fermentation system was designed and constructed to study the growth characteristics of micro-organisms at low and high cell concentrations. The technique used to develop high cell densities utilized a rotating micro-filtration unit to permit the removal of cell-free product from the fermenter. The fermenter volume and the filter were contained in a single unit composed of a series of

concentric cylinders. The annuli served as the fermenter volume while the second outermost cylinder supported a micro-filtration membrane. Feed to the system was pumped at constant rates and the internal pressure built up to a value which would effect the required filtration rate. The system was operated batchwise and continuously with and without filtration. The anaerobic growth characteristics of Streptococcus faecalus were determined at 37°C and pH 7.0 for batch, continuous and continuous with filtration modes of operation. Cell concentrations 45 times more concentrated than could be produced in batch culture were obtained using the filtration technique. Dissert. Abstr.

N70-18952*# Department of Health, Education, and Welfare, Phoenix, Ariz. Applied Microbiology and Planetary Quarantine Section.

SERVICES PROVIDED IN SUPPORT OF THE PLANETARY QUARANTINE REQUIREMENTS OCTOBER – DECEMBER 1969

1968 18 p

(NASA Order R-137)

(NASA-CR-108101; Rept-28) Avail: CFSTI CSCL 06M

The research and developments in the planetary quarantine program are reported for this period. Among the projects discussed are: (1) Spore isolates from Mariner Mars 69 were identified to species in order to determine any possible correlation between spore types and dry heat resistance. (2) Dust samples were collected at Cape Kennedy from various assembly, manufacturing, and testing areas for evaluation of subcultural spores having heat resistance. (3) A commercially available, vertical laminar flow biological safety cabinet was evaluated for efficiency in providing product protection and containment. It was found that contamination generated inside the cabinet tended to spread to other points in the work area before being exhausted from the cabinet. (4) Microbial contamination of electronic components was studied. (5) Microbial studies were performed on the Apollo 12 spacecraft. F.O.S.

N70-19091*# Food and Drug Administration, Cincinnati, Ohio. Div. of Microbiology.

ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Progress Report, 1 Jul.-30 Sep. 1969

R. B. Read, Jr. Nov. 1969 18 p

(NASA Order R-36-015-001)

(NASA-CR-107933; QPR-18) Avail: CFSTI CSCL 06M

Processes involved with thermal inactivation determinations were examined. Emphasis was placed on: (1) heat penetration studies of the heat exposure system and modification to accommodate stainless steel cups in lieu of tubes used in previous studies, (2) comparison of D values as obtained from plate-count and most-probable-number data, and (3) studies on the rate of cross contamination between cups in the test system. Cultures from Apollo 11 were examined for growth characteristics, colony appearance, and pigment production. Tables of various culture properties data are included. D.L.G.

N70-19125*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

DETECTION OF FETAL LIFE AND MEASUREMENT OF THE INFANT SKULL USING THE TWO-DIMENSIONAL ULTRASONIC ECHO METHOD [UBER DEN NACHWEIS FETALEN LEBENS UND DIE MESSUNG DES KINDLICHEN SCHAEDELS MITTELS DES ZWEIDIMENSIONALEN ULTRASCHALLECHO-VERFAHRENS]

D. Hofmann et al Washington NASA Feb. 1970 3 p refs Transl. into ENGLISH from Gynaecologia (Karger), v. 165, 1968 p 60-61

(Contract NASw-1692)

(NASA-TT-F-12852) Avail: CFSTI CSCL 06E

An accuracy of 100% in detection of fetal life during the 12th to 42nd weeks of pregnancy is claimed, using the B-image method of ultrasonic examination. The advantages of the latter over the A-image method and fetal electrocardiography are stressed. It is apparent that the B-image method can be used for fetal skull measurement by the end of the 4th month of pregnancy at the very latest. Author

N70-19199*# Agence Tunisienne de Public-Relations, Tunis (Tunisia).

ABOUT THE INFLUENCE OF GRAVITY ON THE SLEEP MOVEMENTS ON LEAVES, PART 3 [UEBER DEN EINFLUSS DER SCHWERKRAFT AUF DIE SCHLAFBEWEGUNGEN DER BLATTER, 3]

Alfred Fischer Washington NASA Feb. 1970 17 p refs Transl. into ENGLISH from Botan. Zeitung (German), v. 48, no. 44, 31 Oct. 1890, Columns 705-718 Sponsored by NSA and NSF

(NASA-TT-F-12619; TT-70-58009) Avail: CFSTI CSCL 06B

Clinostatic experiments with plants having their leaves in sleep position showed that their nyctitropical sensibility weakened and finally was almost destroyed by elimination of the unilateral gravitational effect. Complete suspension of leave sleep movements was reached after gradual suppression at about the fourth or sixth day. Bending resistance in the joints of rotated beans remained approximately the same during both the day and the night after sleep movements had ceased. Strong heliotropical movements produced by bean leaves on an axis vertical to the window showed that only the nyctitropical but not the heliotropical movement sensibility was reduced by elimination of the unilateral gravitational effect. G.G.

N70-19211# School of Aerospace Medicine, Brooks AFB, Tex. Sealed Environment Branch.

AN AUTOMATED METHOD FOR QUANTIFYING URINARY PEPTIDES AND FREE AMINO ACIDS Final Report, 1965-1967

James P. Ellis, Jr., J. M. Prescott, and B. E. Welch Sep. 1969 35 p refs Submitted for publication

(AD-697382; SAM-TR-69-55) Avail: CFSTI CSCL 6/1

An automated method is described for the simultaneous quantitative analysis of urinary peptides and free amino acids. A novel ninhydrin reagent rendered the method particularly sensitive for the analysis of peptides containing amino acid residues. The method utilizes the hydrolysis and analytic components of a commercial peptide analyzer and the chromatographic and colorimetric recording components of a commercial amino acid analyzer. The method readily facilitates the analysis of one urine sample per day. A brief account is given of the developmental phase of this methodology. Applicability of the method is demonstrated by duplicate analyses of three samples collected from one subject and single analyses of two samples collected from each of three subjects. These data suggest the method yields reasonably reproducible results and that the quantitative excretion patterns of some peptides and amino acids may differ between subjects but are relatively the same for a given subject. Author (TAB)

N70-19218# Missouri Univ., Columbia.

THYROID SECRETION RATE AND LACTATION

Ralph R. Anderson [1969] 16 p refs Presented at the 5th Midwest Conf. on the Thyroid, Columbia, Mo. Sponsored by AEC

(COO-1758-10; Conf-690215-1) Avail: CFSTI

In rats and cattle, the thyroid hormone secretion rate was determined with the substitution method using subcutaneous injections of I-131 and thyroxine. An increase in TSR of 100% was observed in lactating rats. However, the low correlation coefficient of 0.2 between TSR and milk production served to indicate that the other six hormones known to influence milk synthesis or removal must also play a significant role in controlling the level of milk production. The correlation coefficient of 0.29 between TSR and milk production obtained from 32 observations in cows confirmed this concept. NSA

N70-19266*# Wisconsin Univ., Madison. Dept. of Bacteriology.
STABILITY OF VIRUSES IN FOODS FOR SPACE FLIGHTS Technical Report, 1 Dec. 1968 – 30 Nov. 1969
Dean O. Cliver Nov. 1969 28 p
(Grant NGR-50-002-086)
(NASA-CR-107947) Avail: CFSTI CSCL 06M

Final results are presented for a study to determine the extent to which various viruses in space flight foods remain stable during storage. Earlier tasks established that although viruses sometimes contaminate food, they apparently cannot multiply in it. The present work involved testing a broader range of viruses, including influenza, polio, and enteric intestinal types, and investigating temperature effects on their activation. Particular emphasis was placed on analyzing differences in polio virus stability among various food components under varying thermal conditions. The contributions of moisture levels in food containing this infective were also evaluated. One experiment was conducted to determine the effectiveness of freeze drying on virus stability in cream style corn, in which polio virus was inactivated 0.01. The remaining virus was very stable during storage of the product at 5 degrees centrigrade. A.C.R.

N70-19267*# Agence Tunisienne de Public-Relations, Tunis (Tunisia).
CONCERNING THE INFLUENCE OF GRAVITY ON THE SLEEP MOVEMENTS OF LEAVES [UEBER DEN EINFLUSS DER SCHWERKRAFT AUF DIE SCHLAFBEWEGUNGEN DER BLATTER]
Alfred Fischer Washington NASA Feb. 1970 12 p refs Transl. into ENGLISH from Botan. Zeitung (German), v. 48, no. 42, 17 Oct. 1890 Columns 673 – 683 Sponsored by NASA and NSF
(NASA-TT-F-12614; TT-70-58008) Avail: CFSTI CSCL 06C

The effects of gravity on the movements necessary for attaining the fixed light position of leaves were studied in an attempt to gain further knowledge of the secondary factors, other than primary light conditions, that cause this phenomenon. Present work involved inversion experiments with leaves in an overturned position to investigate the viewpoint that sleep movements of plants can be changed by various external conditions. Data obtained from samples of Phascolus vulgaris rotated around a horizontal axis are tabulated and compared with the positions of an upright plant at various points in time. Results indicate that sleep movements are quickly suspended upon elimination of gravitational forces, and that they return as soon as the gravity reassumes its unilateral effect. A.C.R.

N70-19362# School of Aerospace Medicine, Brooks AFB, Tex.
ISOLATION PROCEDURE, STRUCTURAL CHANGES, AND ENZYMATIC ACTIVITY OF PARTICULATE SUBCELLULAR FRACTIONS OF RAT KIDNEY HOMOGENATES Interim Report, Jan.-Aug. 1968
James W. Frazier and Charles L. Martin Sep. 1969 16 p refs Submitted for publication
(AD-697383; SAM-TR-69-56) Avail: CFSTI CSCL 6/1

Previous data suggested that reversible structural changes occur in mammalian kidneys exposed to hypoxia. Since one of the concomitants of tissue hypoxia is swelling, with an uptake of external sodium ion, the formed elements of kidney homogenates were isolated in media containing 0.15 M NaCl, 0.15 M KCl, or 0.3 M sucrose in order to mimic ionic conditions surrounding these structures in normoxic and hypoxic conditions and to compare these with usual nonionic isolation procedures capable of producing relatively intact structures. NADH oxidase, ATPase, and light-scattering changes on acidification were measured. It was found that both cations had deleterious effects on NADH oxidase and light-scattering changes of mitochondrial and microsomal fractions. The 0.15 M KC1 acted as a stimulator of microsomal ATPases and supported mitochondrial ATPases. The 0.15 M NaCl caused a dramatic inhibition of mitochondrial ATPases, but produced nearly the same microsomal ATPase activity as microsomes isolated in sucrose. These results indicate rather dramatic regulatory effects of monovalent cations on energy-utilizing (ATPases) and energy-producing (NADH oxidases) cellular reactions, together with striking effects on sensitivity of structural elements to changes in hydrogen ion content, as shown by light-scattering measurements. Author (TAB)

N70-19374*# Agence Tunisienne de Public-Relations, Tunis (Tunisia).
ON THE IMPORTANCE OF THE FORCE OF GRAVITY FOR THE DEVELOPMENT OF THE ANIMAL EMBRYO [ZUR FRAGE VON DER BEDEUTUNG DER SCHWERKRAFT FUER DIE ENTWICKLUNG DES TIERISCHEN EMBRYO]
Oskar Schultze Washington NASA Feb. 1970 31 p refs Transl. into ENGLISH from Arch. Mikroskop. Anat. (German), v. 56, 1900 p 309-334 Sponsored by NASA and NSF
(NASA-TT-F-12584; TT-70-58001) Avail: CFSTI CSCL 06C

Gravitational effects on the development of fertilized frog eggs were studied experimentally. It was shown that the force of gravity must strike the egg axis at an angle of zero degree because under all other angular positions between zero and 180 degree, malformations proportional to the size of the angle arise or death occurs. G.G.

N70-19375*# Agence Tunisienne de Public-Relations, Tunis (Tunisia).
ON THE INFLUENCE OF GRAVITY IN ORGANIC FORMATION AND THE POSSIBLE ARTIFICIAL INDUCTION OF DIMORPHISM BY THE USE OF GRAVITY [UEBER DIE BEDEUTUNG DER SCHWERKRAFT FUER DIE ORGANISCHE GESTALTUNG, UBER DIE MIT HULFE DER SCHWERKRAFT MOGLICHE KUNSTLICHE ERZEUGUNG VON DOPPELBILDUNGEN]
O. Schultze Washington NASA Feb. 1970 25 p refs Transl. into ENGLISH from Sitzungsber. Physik. - Med. Ges. Wurzburg (German) New Ser. 28, no. 2, 1894 p 1-22 Sponsored by NASA and NSF
(NASA-TT-F-12577; TT-70-58005) Avail: CFSTI CSCL 06C

It is demonstrated that for the normal development of a fertilized frog egg the right gravitational effect is necessary, i.e. the conditions where the egg axis takes the vertical direction and where the light pole is at the top. Absence of these conditions leads to constantly arising modifications in the normal formation process and the ultimate death of the egg. Author

N70-19376*# Pennsylvania State Univ., University Park. Dept. of Biophysics.
PHYSICS OF CELLULAR SYNTHESIS, GROWTH AND DIVISION Status Report, 1 Jul. – 31 Dec. 1969
E. C. Pollard Jan. 1970 14 p refs
(Grant NGR-39-009-008)
(NASA-CR-108172) Avail: CFSTI CSCL 06C

Work in theoretical biology indicates that the mammalian cell adaptation mechanism to ionizing radiation, which achieves the complete destruction of the damaged nucleic acid resulting from high energy release of ionization, has a strong relationship to a membrane bound enzyme pool. A three dimensional analysis, consisting of electron microscopy, optical diffraction, and mathematical reconstruction, is advocated for evaluating spatial structures of ribosomal crystals. Investigations into the involvement of biogenic amines in long term memory establish the participation of norepinephrine in long term memory processes. DNA homology studies in mice indicate differences between male and female animals and also between mouse-rat and mouse-opossum relationships; mice and rats have 45 percent of their DNA in common whereas mice and opposums have only 29 percent of their DNA in common. Amber suppressors in a bacterium or bacteriophage messenger DNA which cause the effective translation of only the amber codon produce altered transfer RNAs which cause the insertion of serine, glutamine, and tyrosine, respectively, at the side of the amber codon. Evidence is presented that ochre suppressors are derived from each of the three amber suppressors by means of a specific mutagen decay. G.G.

N70-19481# Atomic Energy Establishment, Winfrith (England).
PROPORTIONAL COUNTERS FOR MEASURING Pu-239 IN VIVO: THE CHOICE OF COUNTING GAS AND THE USE OF PULSE SHAPE DISCRIMINATION TECHNIQUES
R. A. Pike and D. Ramsden Aug. 1969 15 p refs
(AEEW-M-912) Avail: CFSTI

The system for determining insoluble plutonium in vivo, now in routine use at A.E.E. Winfrith, has a limit of detection of the order of 4 nCi plutonium-239. The method of reducing background by using pulse shape discrimination techniques while retaining a high detection efficiency is described. The choice of a counting gas mixture to obtain optimum performance is discussed as are the techniques of gas handling. Author (NSA)

N70-19507*# Acence Tunisienne de Public-Relations, Tunis (Tunisia).
REMARKS ABOUT O. SCHULTZE'S WORK ON THE NECESSITY OF FREE DEVELOPMENT OF THE EMBRYO AND THE NORMAL EFFECT OF GRAVITATION ON DEVELOPMENT [BEMERKUNGEN ZU O. SCHULTZE'S ARBEIT UBER DIE NOTHWENDIGKEIT DER FREIEN ENTWICKELUNG DES EMBRYO SOWIE DER NORMALEN GRAVITATIONSWIRKUNG ZUR ENTWICKELUNG]
W. Roux Washington NASA Feb. 1970 22 p refs Transl. into ENGLISH from Arch. Entwicklungsmech. Organ. (Berlin), v. 9, 1900 p 479-493 Sponsored by NASA and NSF
(NASA-TT-F-12549; TT-70-58000) Avail: CFSTI CSCL 06C

In opposition to a report that proclaims the necessity of free development for the embryo and the normal effect of gravitation on this development, the following conclusions are reached: (1) the normal gravitational effect is not necessary for the development of eggs and embryos; (2) by abnormal re-arrangement of the ingredients of the egg differing in specific gravity, the abnormal effects of the force of gravity become harmful and fatal; (3) the normal mobility of the egg and embryo in egg membranes is, in itself, not necessary for development yet its restriction can under certain circumstances cause abnormal effects of gravity and thus be harmful; and (4) the arrangements which make the movement of eggs and embryos in their membranes possible are there because the abnormal effects of the ever present and acting force of gravity are obviated. G.G.

N70-19508*# Agence Tunisienne de Public-Relations, Tunis (Tunisia).
CORRECTION OF O. SCHULTZE'S LATEST ARTICLE ON IMPORTANCE OF THE FORCE OF GRAVITY FOR THE DEVELOPMENT OF THE ANIMAL EMBRYO AND OTHER [BERICHTIGUNGEN ZU O. SCHULTZE'S JUNGSTEM AUFSATZ UBER DIE BEDEUTUNG DER SCHWERKRAFT FUER DIE ENTWICKELUNG DES TIERISCHEN EMBRYO UND ANDERES]
W. Roux Washington NASA Feb. 1970 19 p refs Transl. into ENGLISH from Arch. Entwicklungsmech. Organ. (Berlin), v. 10, 1900 p 244-255 Sponsored by NASA and NSF
(NASA-TT-F-12587; TT-70-58003) Avail: CFSTI CSCL 06C

The author proved in earlier rotation experiments that the normal directing effect of the force of gravity is not necessary for the development of frog eggs. This observation is used to refute a study showing that eggs set up in a normal position and kept in an induced state by appropriate dryness remained stationary in the gastrula stage by lack of the normal effects of the force of gravity; rather, it is felt that these phenomena are attributable to a lack of air and too hard pressing caused by the excessive dryness. The circumstance that, after adding water, the eggs continue to develop is rather attributed to the elimination of these harmful effects than to the fact that the eggs now rotate a bit and can adjust themselves exactly to the direction of the earth's axis. G.G.

N70-19509*# Agence Tunisienne de Public-Relations, Tunis (Tunisia).
CONCERNING THE NECESSITY OF THE FREE DEVELOPMENT OF THE EMBRYO [UEBER DIE NOTWENDIGKEIT DER FREUEN ENTWICKLUNG DES EMBRYO]
Oskar Schultze Washington NASA Feb. 1970 37 p refs Transl. into ENGLISH from Arch. Mikroskop. Anat. (German), v. 55, 1899 p 202-230 Sponsored by NASA and NSF
(NASA-TT-F-12585; TT-70-58002) Avail: CFSTI CSCL 06C

It is shown experimentally that frog eggs with a controlled degree of membrane swelling, which suspends their capability to re-orient their inner substance by rotations, do not develop further. Not only is division inhibited at the lower egg pole containing less protoplasma, but cell division already accomplished is rapidly destroyed. Eggs in a highly induced state and with the light pole turned down can reach the end of gastrulation but never develop medullary bulges under above described circumstances. G.G.

N70-19514# Indiana Univ., Bloomington.
EFFECT OF IONIZING RADIATION ON RECURRENT INHIBITION OF THE SPINAL CORD
Charles D. Barnes [1969] 18 p refs
(Contract AT(11-1)-1475)
(COO-1475-5) Avail: CFSTI

Cats were decerebrated and dorsal and ventral roots of lumbar nerves were exposed. Radiation doses of 200 to 5,000 rads were administered to the brain stem and spinal cord, and results were recorded in the form of a histogram. Early radiation changes were detected with the lowest doses. Figures are presented to show effects of acute radiation on the brainstem conditioned lumbar spinal cord extensor and flexor monosynaptic reflexes from the gastrocnemius and common peroneal muscles. It was found that increased doses led to inhibition of the unconditioned monosynaptic even if the early effect of radiation was facilitation. The effect of the removal of the cerebellum on the histogram patterns of the animal prior to radiation showed a lack of the long latency facilitation or inhibition that was seen in noncerebellectomized animals. Effects of radiation on short and long latency responses are discussed. It is thought that much of the effect of radiation on the brainstem-cord interactions is a result of the effect on the cerebellar Purkinje cells. It is suggested that if the radiosensitivity is further verified it will provide a useful tool for studying cerebellar-brainstem-cord interactions. NSA

N70-19619# Stanford Linear Accelerator Center, Calif.
UNDESIRABLE SECONDARY RADIATION IN THE IRRADIATION SPACE OF A SIEMENS 42-MeV BETATRON
J. Rassow, H.-D. Strueter, and E. Lacin 1968 26 p refs Transl. into ENGLISH from Strahlentherapie, (Munich), v. 136, 1968 p 183-195
(SLAC-Trans-100) Avail: CFSTI

The radiation transmitted by the casing as affected by the construction at all exterior surfaces adjoining the instrument head was measured on the 42 MeV Siemens betatron The highest dose rate for all irradiation parameters was only 5% of the beam, and 0.4% at the level of the patient. The total secondary radiation from the phantom is an order of magnitude higher than the transmitted radiation at a distance of 50 cm from the irradiated field. The part of the hard component (HVL about 17 mm Pb) amounts to 15 to 60% of the secondary radiation at distances of 25, 50, and 100 cm from the central axis, but 100% of the transmitted radiation. The ambient doses in the treatment room were studied (for vertical and horizontal beams) with and without a phantom. All measurements were made with electrons and photons of 43 MeV peak energy. To allow calculations of the protective walls, the dose rates at a distance of 50 cm inside the walls are given for the largest field as a function of the thickness of the phantom and for the different beam compensators. Author (NSA)

N70-19627# Oak Ridge National Lab., Tenn.
ENERGY AND ANGULAR DISTRIBUTION OF NEUTRONS AND GAMMA RAYS: OPERATION HENRE
J. H. Thorngate, D. R. Johnson, and P. T. Perdue Aug. 1969 75 p refs
(CEX-65.11) Avail: CFSTI

The HENRE experiment, conducted at the Nevada Test Site in the winter and summer of 1967, was an extension of the experimental programs related to the Ichiban program to determine the doses received by the survivors at Hiroshima and Nagasaki. The data obtained on the neutron and gamma-ray dose as a function of polar angle, the fast neutron spectrum as a function of distance, and the high energy gamma-ray spectrum as a function of polar angle are presented. It was found that the neutron spectrum did not reach equilibrium within the distances at which measurements were made. This has an effect on the dose as a function of polar angle measured with different air densities. In addition, the measurements show the gamma-ray dose received from angles below the air-ground interface is affected by the diffuse source of gamma rays. Where possible, these data have been compared with data from previous field experiments. In every case, they were compared with calculations which approximated the experiment. Agreement in both cases is generally good, and this strengthens confidence in calculated results. Author (NSA)

N70-19643# Rochester Univ., N.Y. Dept. of Radiation Biology and Biophysics.
STUDIES WITH RADIOTHORIUM TH-228 ENRICHED THORIUM DIOXIDE AND ITS RADIOACTIVE PROGENY
John Edgerton Ballou (Ph.D. Thesis) 1969 154 p refs Sponsored by AEC
(UR-49-1153) Avail: CFSTI

The Ra-224 and Pb-212 daughters in ThO2 were preferentially solubilized and translocated from deposits of the oxide in muscle, in the major reticuloendothelial organs and from the lung air space and vascular system. The extent of the washout varied with the primary site of ThO2 deposition, but as a rule the lead isotope was depleted to a twofold greater extent than its radium precursor. A major portion of the Pb-212 deficit could be attributed to loss of the immediate parent of Pb-212, thoron in the expired air. The balance of the translocated Pb-212 accumulated in red blood cells and liver in the ratio of 5:1, respectively. The concentration of Pb-212 in blood appeared to reflect the amount of ThO2 in the dog, regardless of deposition site. Author (NSA)

N70-19655# Scottish Research Reactor Centre, East Kilbride.
COMPARISON OF METHODS TO ASSESS GEOMETRICAL VARIATIONS OF THE COUNTING-RATE IN WHOLE-BODY MONITORS
Keith Boddy, Barbara M. Holmes, Priscilla C. King and Donald M. Dunn Dec. 1968 27 p refs
(SRRC-31/69) Avail: CFSTI

The variation in the counting-rate of a whole-body monitor, due to redistribution of an administered isotope in the body, has been investigated by three methods. Point sources in simple water phantoms including a life-like phantom containing simulated organs and human subjects were studied. The results from all methods were in reasonable agreement. The point source study showed that changes in the depth of the isotope in the body caused greater variation of the counting-rate than changes in longitudinal or lateral position, and realistic quantitative estimates of the variation were obtained. It is suggested that this simple method might be a suitable basis for inter-laboratory comparisons. Confirmatory data on human subjects are supplied by the routine use of the whole-body monitor. It was found that the use of an elaborate phantom, which may be expensive to purchase, is comparatively time-consuming and is probably unnecessary. Author (NSA)

N70-19685# Atomics International, Canoga Park, Calif.
RADIATION CHEMISTRY OF CHROMOSOMES, DECEMBER 1968-30 JUNE 1969
R. A. Holroyd and M. D. Sevilla 27 Jun. 1969 451 p refs
(Contract AT(04-3)-701)
(AI-AEC-Memo-12861) Avail: CFSTI

Chromosomes and chromosome constituents were exposed to electrons and hydrogen atoms, which are intermediates expected to be produced by ionizing radiation. The reactions of hydrogen atoms with purines and pyrimidines were studied and characteristic ESR spectra were obtained for each base. It was then possible to study the reactions of hydrogen atoms with DNA. It was found that hydrogen atoms react non-specifically by addition to the bases in DNA. The presence of histones was found to inhibit hydrogen atom attack on the DNA and result in preferential formation of radicals in the histone component. A tritium labeling technique was used to identify the radical sites on various amino acids of the histone samples. A high degree of specificity was found in that 67% of the radicals formed were on lysine residues. It was found that electrons reacted readily with adenine, cytosine, thymine, and uracil to form anions; but only the thymine anion reacted further by protonation. Interpretation of the ESR spectrum showed that protonation occurs at the 6-position of thymine. Author (NSA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N70-18310*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif.
EMERGENCY EVAPORATIVE COOLANT GARMENT SYSTEM/LIQUID-COOLED GARMENT (EECGS/LCG), PHASE 2 Final Report
J. G. Bitterly Dec. 1969 136 p refs
(Contract NAS9-7207)
(NASA-CR-102153; MDC-G1220) Avail: CFSTI CSCL 06K

A new concept high-performance Evaporative Cooling Garment System (ECGS) is developed. An investigation of the potential of the ECGS concept was applied to an emergency cooling system to supplement the current Liquid-Cooled Garment (LCG). The requirements further stipulated that the presence of the Emergency Evaporative Cooling Garment System (EECGS) should not affect the normal operation and/or effectiveness of the LCG. The only exposed areas of the body not covered by the LCG were the collar, head, hands, and feet. Since the LCG was not to be compromised in any way, the only possible way to obtain maximum cooling potential was to cool through the LCG along with cooling the unused body surface areas. The EECGS, therefore, had to be integrated with the LCG forming an EECGS/LCG. The target performance was to provide cooling for 30 minutes at 3,000-Btu/hr metabolic rate, all on ECGS self-contained internally stored expendables (water); and to operate with the LCG at zero cooling rate. Author

N70-18311*# AiResearch Mfg. Co., Los Angeles, Calif. Dept. of Life Sciences.
EVALUATION OF THE METABOLIC COST OF LOCOMOTION IN AN APOLLO SPACE SUIT
W. G. Robertson and E. C. Wortz Jan. 1970 48 p refs
(Contract NAS9-9459)
(NASA-CR-102154; Rept-69-5909) Avail: CFSTI CSCL 06K

In a series of tests conducted with the A7L space suit, six subjects performed locomotion exercises under conditions that simulated lunar gravity. Independent variables were treadmill velocity, walking surface, and lunar gravity simulation technique. The primary dependent variable was the level of energy expenditure of

the subjects. In this report, conclusions are drawn about the average metabolic rates for each task, the effects of surface conditions, the effects of simulation technique employed, and the differences between different types of space suits. Author

N70-18342# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CONSTRUCTION OF A RECTIFYING SPACE FOR PATTERN RECOGNITION
V. I. Belyakov-Bodin 12 Mar. 1969 18 p refs Transl. into ENGLISH from Vychislitel'nyy Tsentr. Akad. Nauk SSSR (Moscow), 1967 p 13-23
(AD-696499; FTD-HT-23-1094-68) Avail: CFSTI CSCL 6/4

Automata termed artrons (artificial neurons, i.e. neuron models or mathematical models of threshold elements), which have n binary inputs, a binary output and are capable of learning how to separate input situations into two classes, have recently begun to be often employed for pattern recognition. Two possible cases are considered. Either the reception field can be compared with coordinate unit vectors in Euclidean n-variate space X, such that the various input situations forming the set of nodes of the n-variate cube will be separated by a hyperplane in X (case 1), or the classes in X are not separated by a hyperplane and then transition from the X-space to the so-called rectifying Z-space, in which separation of these classes by a hyperplane is feasible, is needed (case 2). The article examines certain aspects of the construction of the Z-space. The n-th degree polynomial is proposed as the logic separating function. TAB

N70-18528*# Oakland Univ., Rochester, Mich. School of Engineering.
BIOSYSTEMS ENGINEERING RESEARCH Quarterly Progress Report
J. E. Gibson, J. C. Hill, R. E. Haskell, and R. H. Edgerton 30 Oct. 1969 161 p refs
(Grant NGR-23-054-003)
(NASA-CR-107927; QPR-2) Avail: CFSTI CSCL 06B

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1. MUSCULAR COORDINATION AND MULTI-DEGREE OF FREEDOM CONTROL SYSTEMS J. C. Hill p 4-44 refs (See N70-18529 07-04)

2. NASA BIOSYSTEMS: BIO-OPTICS R. H. Edgerton p 45-60 refs (See N70-18530 07-04)

3. PATTERN RECOGNITION OF RANDOM SPATIAL SIGNALS USING COHERENT OPTICAL TECHNIQUES R. E. Haskell p 61-81 refs (See N70-18531 07-05)

4. MANUAL CONTROL SYSTEMS RESEARCH G. A. Jackson p 82-96 refs (See N70-18532 07-05)

5. A MODEL OF THE HUMAN POSTURAL CONTROL SYSTEM J. C. Hill 12 p refs (See N70-18533 07-04)

6. FORMAC SOURCE PROGRAM GENERATING THE EQUATIONS OF MOTION OF THE SEVEN ELEMENT STICK MAN J. C. Hill 9 p refs (See N70-18534 07-08)

7. CALCULATION OF THE DIELECTRIC CONSTANT OF A SUSPENSION OF SYMMETRIC ELLIPSOIDS IN A SIMPLE SHEAR FLOW R. H. Edgerton 12 p refs (See N70-18535 07-12)

8. DETERMINATION OF THE ERROR COST FUNCTIONAL USED BY HUMAN OPERATORS WHILE CONTROLLING CERTAIN COMPENSATORY SYSTEMS G. A. Jackson 30 p refs (See N70-18536 07-05)

N70-18531*# Oakland Univ., Rochester, Mich. School of Engineering.
PATTERN RECOGNITION OF RANDOM SPATIAL SIGNALS USING COHERENT OPTICAL TECHNIQUES
R. E. Haskell *In its* Biosystems Eng. Res. 30 Oct. 1969 p 61-81 refs (See N70-18528 07-05)
Avail: CFSTI CSCL 06P

Described is an optical processing system for power spectrum and autocorrelation measurements that uses one lense for both transforming and imaging the input signal so that the incident wave need not be a plane wave. The single lense can be replaced by a spherical mirror. Also developed is a general computer technique for generating random spatial patterns with known statistical characteristics that use an an appropriate random function generator on a digital computer to locate a random point as a spot on an oscilloscope face. A large number of random points can then be plotted rapidly and photographed for optical identification. G.G.

N70-18532*# Oakland Univ., Rochester, Mich. School of Engineering.
MANUAL CONTROL SYSTEMS RESEARCH
G. A. Jackson *In its* Biosystems Eng. Res. 30 Oct. 1969 p 82-96 refs (See N70-18528 07-05)
Avail: CFSTI CSCL 05H

Briefly outlined are individual studies on optimal properties of the human operator and the design of an arm movement control stick. Manual control research activities deal with fast parameter identification methods and human operator adaptation in changing control systems. Considered is a hybrid modification of the continuous parameter tracking method that centers on on-line identification of the crossover model parameters, as well as a continuous parameter tracking method with simultaneous real-time sampling of the compensatory system and fast-time iterations into the continuous parameter tracking model. Also described is an hybrid identification technique utilizing estimates by stochastic approximation. G.G.

N70-18536*# Oakland Univ., Rochester, Mich. School of Engineering.
DETERMINATION OF THE ERROR COST FUNCTIONAL USED B HUMAN OPERATORS WHILE CONTROLLING CERTAIN COMPENSATORY SYSTEMS
Glenn A. Jackson *In its* Biosystems Eng. Res. 30 Oct. 1969 30 p refs Sponsored in part by NSF (See N70-18528 07-05)
(Grant NSF GK-3490)
Avail: CFSTI CSCL 05H

The purpose of this research was to determine the error cost functional used by human operators while controlling low order compensatory control sytems. The systems investigated were limited to those cases where the model of the forward loop of the control system—including human operator and controlled element—was satisfactorily represented by a crossover model. This forward loop model consists entirely of a gain, a time-delay, and a single integration. This simple model is applicable for a fairly wide range of low order controlled elements. Author

N70-18657*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ON CRITICAL PILOT TASKS
D. C. Miller and J. Markowitz 22 Dec. 1969 23 p
(Contract NAS2-5108)
(NASA-CR-73408; Rept-1924) Avail: CFSTI CSCL 05J

The possibility of formally defining and classifying critical pilot tasks is considered. To include both the elements of danger and complexity a critical pilot task is defined as one that affords a low probability of recovery from an incorrect pilot decision or control action. Three basic reasons for a task being critical are given: the task may have to be performed in a very narrow time window, it may involve an operation near some limit of aircraft performance, and it may involve an operation near some limit of pilot capability. Emphasis is placed on the pilot's decision-making capabilities. Author

N70-18885 Catholic Univ. of America, Washington, D.C.
A STUDY OF STATISTICAL TECHNIQUES IN THE RECOGNITION OF HAND-PRINTED CHARACTERS
Michael Emory Wilmer (Ph.D. Thesis) 1968 58 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9121

The design of a machine capable of automatically recognizing hand-printer alphanumeric characters was approached as a representative pattern recognition problem. The machine was separated into three parts; namely, the scanner, the measurement device, and the decision device. The primary goal was the evolution of a systematic design approach for the measurement device. In order to obtain reasonable estimates regarding the required scanner resolution and the required machine complexity, the two dimensional information content of a sample of hand-printed characters was estimated using thirty-five alphabets. The effect of scanner resolution on information content was investigated by the simulation of lower resolution scanners. A model for the information content was generated to account for the presence of noise in the scanned characters. This model was employed to justify the use of a 12 by 12 binary matrix for character representation. Dissert. Abstr.

N70-19004# Aeronautical Research Labs., Melbourne (Australia).
SIMULATED HEAD IMPACT ON A FIBREGLASS SEAT BACK
S. R. Sarrailhe and B. M. Hearn Jun. 1969 14 p refs
(ARL/SM-342) Avail: CFSTI

An airline seat back was impacted with a dummy head at velocities of 30 to 37 f.p.s. to determine head deceleration that could occur in an aircraft crash. The seat back had a fibreglass shell and rigid foam plastic core. Head decelerations were generally less severe than those developed in similar tests on a tubular steel seat back. The fibreglass construction improves passenger safety, but the best way to protect the head is to prevent impact by providing upper torso restraint. Author

N70-19288*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
AIR REGENERATION IN SEALED ENVIRONMENTS: A LITERATURE SURVEY [LUCHZUIVERING IN GESLOTEN RUIMTEN: EEN LITERATUUROVERZICHT]
I. P. Sluimer Washington NASA Feb. 1970 28 p refs Transl. into ENGLISH from Chem. Lab., RVO-TNO Rept., 1968 40 p
(Contract NASw-1692)
(NASA-TT-F-12841) Avail: CFSTI CSCL 13A

A literature survey is given for systems for air regeneration. Attention was paid mainly to pure chemical systems. Electrochemical and biochemical systems are dealt with only briefly. Special attention was given to combined sources of oxygen evolution and carbon dioxide absorption. A comparison of several systems concerning weight, volume, and heat evolution was made. Author

N70-19309*# Honeywell, Inc., Lexington, Mass. Radiation Center.
DESIGN OF A BREADBOARD REMOTE OCULOMETER
Kenneth A. Mason and John Merchant Washington NASA Feb. 1970 43 p
(Contract NAS12-531)
(NASA-CR-1459) Avail: CFSTI CSCL 06B

In order to prove the feasibility of the remote Oculometer concept, a breadboard of the device was designed and fabricated. This involved (1) a new optomechanical unit appropriate to the remote Oculometer, (2) a two axis moving mirror assembly, and (3) an additional electronics unit with which to control the moving mirror rotation angles. When these items were completed they were integrated with the electronics unit originally built for the laboratory Oculometer. Testing of the assembled remote Oculometer indicated that the expected performance was achieved. Photographs of the breadboard device (exclusive of the laboratory Oculometer electronics) are given. This document describes the design of the optics and the moving mirror subsystem that were required for the breadboard remote Oculometer. Author

N70-19329 Oregon State Univ., Corvallis.
AN INTERACTIVE MAN-HYBRID COMPUTER PARAMETER SEARCH ALGORITHM
Max Joseph Morgan (Ph.D. Thesis) 1969 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-8062

An interactive man-hybrid computer algorithm is presented for searching a set of dynamic system parameters which effect a compromise between performance characteristics and give satisfactory system sensitivity without any analytical calculations or a priori indices of performance. The parameter search is conducted in a real time design situation in which the computer algorithm provides interfacing functions between the man and the hybrid computer. The interfacing functions include the interpretation and translation of preferential cues into appropriate parameter changes, visual presentation of time response information, operational messages alerting the man of system events, and data outputs. The preferential cues are given by the man in response to his critical examination and judgment of the visual time response information. Experimental results for both linear and nonlinear systems are given along with a discussion of experimental findings on the judgments a man can make with consistency about time response characteristics. Dissert. Abstr.

N70-19355*# Techtran Corp., Glen Burnie, Md.
NEW RESPIRATORY DEVICES FOR RESCUE OPERATIONS RECENTLY PLACED IN SERVICE IN THE MINES OF AUSTRIA AND HUNGARY [LES NOUVEAUX APPAREILS RESPIRATOIRES DE SECOURS RECEMMENT MIS EN USAGE DANS LES MINES DE L'AUTRICHE-HONGRIE]
H. Schmerber Washington NASA Feb. 1970 13 p Transl. into ENGLISH from Genie Civil (Paris), v. 32, 1897-1898 p 359-361
(Contract NASw-1695)
(NASA-TT-F-12838) Avail: CFSTI CSCL 06G

Respiratory devices for use in mine rescue operations are discussed. A portable device providing for the absorption of carbon monoxide and supply of fresh oxygen to the operator, is described. Its principal defect is that the user must maintain a tube in his mouth at all times. Modifications to this device are discussed along with descriptions of various other devices under consideration. Author

N70-19461# Brookhaven National Lab., Upton, N.Y.
SERVO-TELEMANIPULATORS AND THEIR PRESENT AND FUTURE APPLICATIONS
Carl R. Flatau [1969] 27 p Presented at Colloq. on Current and Future Develop. in Teleoperator Techn. and Appl., Denver, 26-27 Feb. 1969 Sponsored by AEC
(BNL-13867; Conf-690213-1) Avail: CFSTI

A manipulator is described which was designed for use at high-energy accelerators, and specifically at Brookhaven. The communication link between the master and slave is described. Applications of servo-manipulators may be included in space exploration. Telemanipulating systems might be applied to coal mining and avoid hazardous disasters to humanity by loss of lives or health. However, to do this, the major problems to be hurdled are social and economic, not technical. NSA

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N70-18325 National Lending Library for Science and Technology, Boston Spa (England).
REFINEMENT OF A MATHEMATICAL MODEL FOR THE FLUID-BED ROASTING OF SULPHUR PYRITE
A. G. D'yachko et al 21 Aug. 1969 18 p refs Transl. into ENGLISH from Sb. Nauchn. Tr., Gos. Nauchn.-Issled. Inst. Tsvetn. Metal. (Moscow), no. 21, 1964 p 168-178 In RUSSIAN and ENGLISH
(NLL-Trans-746-254-(9022.401)) Avail: Natl. Lending Library.

Boston Spa, Engl.: .2 NLL photocopy coupons

An analysis is made of a mathematical model for the fluid-bed roasting process of pyrite in the case when parameter distribution may be ignored. A calculation is given of static characteristics under isothermal conditions. Author

N70-18368# Temple Univ., Philadelphia.
WHY IS C SUB v LESS SINGULAR THAN C SUB p NEAR THE CRITICAL POINT ?
Melville S. Green 1969 34 p refs
(Contract N00014-68-A-0264-0002)
(AD-696568) Avail: CFSTI CSCL 20/13

The fact noted by Schofield that the specific heat at constant volume, albeit singular, is less singular than the specific heat at constant pressure implies an asymptotic relation between the two, three, and four body distribution functions. The experimental background of this fact is discussed and a fluctuation formula which expresses C sub v in terms of two, three and four body correlation functions is derived. A heuristic explanation of the asymptotic properties of the distribution functions is given based on the fact that local fluctuations proportion to the critical eigenvector are overwhelmingly the most probable near the critical point. It is shown that if C sub v is indeed infinite there exists a second critical eigenvector linearly independent of the first. Some consequences of the existence of two critical eigenvectors are discussed and a form for the short range behavior of the distribution functions near the critical point is conjectured. Author (TAB)

N70-18372# Naval Research Lab., Washington, D.C. Chemistry Div.
CHEMI-IONIZATION DURING PLATINUM-CATALYZED OXIDATION OF HYDROCARBON VAPORS
J. E. Johnson, F. J. Woods, and M. E. Umstead *In its* Rept. of NRL Progr. Dec. 1969 p 16 - 44 refs (See N70-18369 07-34)
Avail: CFSTI

Various hydrocarbon vapors have been oxidized in the presence of a heated platinum filament. The observations showed that the yield of ions from the platinum-catalyzed oxidation of hydrocarbon vapors depends greatly on the molecular structure of the given hydrocarbon. The yield of ions was much greater from highly branched alkanes than from n-alkanes. In general, an increase of oxygen content in the gas mixture considerably enhanced the ion yield. With some hydrocarbons, however, the fraction of the material that was oxidized decreased markedly with increased oxygen concentration. An explanation that seems consistent with the data is that at lower temperatures (less than about 400 C) oxidation occurs only on the surface of the platinum, but at higher temperatures the catalytic process extends into the vapor phase. It is suggested further that at higher temperatures dissociative adsorption of oxygen is involved in the ion-producing process. Author

N70-18394# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
AN INTERPRETATION OF BILOBATE INTENSITY STRUCTURE IN RARE GAS BEAMS SCATTERED FROM LiF
J. Doyle McClure Oct. 1969 20 p refs
(D1-82-0920) Avail: CFSTI

Structural attributes of calculated surface rainbow intensity maxima are shown to agree qualitatively with bilobate intensity structure observed in thermal beams of rare gases scattered from single crystal LiF; the scope of correlation encompasses structural variations due to changes in beam energy, angle of incidence, beam specie, and atomic spacing in the azimuth of the incidence plane. These results, which are based on 2D model calculations, imply that mechanisms associated with the bilobate structure differ substantially from those suggested previously. The subject calculations, along with preliminary 3D model calculations, lead to the expectation that a quantitative calculational description of the observed bilobate structure can be obtained. Author

N70-18445# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF LACTIC ACID ON THE ELECTRODEPOSITION OF NICKEL AND IRON ALLOYS WITH TITANIUM
G. I. Kadzhene et al 26 Mar. 1969 10 p refs Transl. into ENGLISH from Proc. of Mat. Resp. Konf. Elektrokhimikov Litovsk. SSR, (VILNA), 1966 p 132-138
(AD-696464; FTD-HT-23-146-69) Avail: CFSTI CSCL 13/8

The possibility was studied of electrolytically depositing Ni-Fe alloys with Ti from solutions of their simple salts by using lactic acid for decreasing the activity of the Fe group metals and inhibiting during electrolysis the formation of basic Ti compounds, which hinder the alloy formation. High-grade precipitates of Ni-Ti alloys in the presence of complexing additions of lactic acid, produced by electrolysis, contain not more than 0.2 percent titanium. In precipitates of an Fe-Ti alloy the quantity of titanium is several times greater. Results of the experiment indicates that the amount of titanium in alloys with nickel and iron depend on the stability of their complex compounds with lactic acid and their normal potentials. Author (TAB)

N70-18456# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINING POLYAMIDE URETHANES FROM HYDROXYETHYL AND HYDROXYPROPYL DERIVATIVES OF DIBASIC ACID AMIDES AND 2,4-TOLUYLENE DIISOCYANATE, REPORT 3
G. A. Yangol et al 2 Sep. 1969 10 p refs Transl. into ENGLISH from Akad. Nauk SSR, Sintez. i Fiz.-Khim. Polimerov (Kiev), 1966 p 55-60
(AD-696310; FTD-HT-23-378-69) Avail: CFSTI CSCL 7/3

Obtained were ten polyamide urethanes based on the dihydroxyethyl and dihydroxypropyl amides of dibasic acids: oxalic, succinic, adipic, azelaic, and sebacic with 2, 4-toluylene diisocyanate in a dioxane medium. The solubility of the product was determined (qualitatively), and a thermogravimetric analysis was carried out. Author (TAB)

N70-18473# Boeing Scientific Research Labs., Seattle, Wash.
PADE APPROXIMANT STUDIES OF LONG RANGE FORCES
K. T. Tang Sep. 1969 40 p refs
(AD-696278; D1-82-0907) Avail: CFSTI CSCL 7/4

Two-point Pade approximants of the dynamic polarizabilities are used to calculate the leading term of the long range (van der Waals) force between atoms. The bounding properties of these approximants are explicitly established. A successive approximation procedure is introduced. It keeps each step simple and makes the higher order approximation expressible in closed forms and readily applicable. The results of hydrogen and noble gases show that, with the known moments, the present method gives the tightest upper and lower bounds yet established. Author (TAB)

N70-18486# Battelle-Northwest, Richland, Wash.
HTGR GRAPHITE: THE RADIOLYTIC REACTION OF GRAPHITE WITH WATER VAPOR
R. E. Woodley *In its* Reactor Fuels and Mater. Develop. Programs for Fuels and Mater. Branch of USAEC Div. of Reactor Develop. and Technol. Aug. 1969 p 4.1-4.2 refs (See N70-18484 07-22)
Avail: CFSTI

Measurements of the radiolytic reaction of graphite-water vapor are presently being carried out in a single-pass flow system. Product concentrations are very small, a few tenths of 1 volume parts per minute. CO2 concentrations of the same magnitude in the helium carrier gas interfere with radiolytic yield determinations. Author (NSA)

N70-18497# Los Alamos Scientific Lab., N.Mex.
FLUORESCENCE EFFICIENCIES AND COLLISIONAL DEACTIVATION RATES FOR M2 AND N2(+) BANDS.

EXCITED FROM DEPOSITION OF SOFT X-RAYS
Kenneth B. Mitchell 3 Nov. 1969 15 p refs
(Contract W-7405-eng-36; ARPA Order 631)
(AD-696664; LA-4248) Avail: CFSTI CSCL 7/4

Efficiencies for excitation of the 3914-A N2(+) first negative band and several prominent N2 second positive bands were measured in pure nitrogen and nitrogen-oxygen mixtures as a function of gas pressure. These nitrogen bands were excited by the deposition of monochromatic x rays in the energy range from 0.9 to 8.0 keV. The efficiency for the 3914-A band in air, at pressures where there is no deactivation, was determined to be 0.53%, and that for the 3371-A second positive band was 0.21%. The efficiencies of these bands were invariant for photon energies between 0.9 and 8.0 keV. The deactivation of the 3914-A band in pure nitrogen follows the Stern-Volmer relationship for two-body processes. Three-body processes are evident in air at pressures above 100 Torr. The quenching constant K in 1/Torr was measured for a variety of first positive bands for the sequences v = 1 to 7. These K values, averaged over all v sequences, were about 3 for nitrogen and 6.5 for air. The first positive bands are deactivated at a rate of 6.5 times the 3914-A band (K = 1.08/Torr) in air. Author (TAB)

N70-18511# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS OF GRAFTED COPOLYMERS OF MODIFIED POLYACRYLONITRILE AND PRODUCTION OF FIBERS BASED ON THEM
M. P. Penkova et al 3 Sep. 1969 9 p refs Transl. into ENGLISH from Karbotsepnya Volokna (Moscow), 1966 p 54-61
(AD-696311; FTD-HT-23-384-69) Avail: CFSTI CSCL 11/5

Acrylonitrile was copolymerized with a small proportion of I. The copolymer (Ia) contained 24.57 percent N, a given molecular weight 45,000-50,000, and sp. viscosity of 0.25 percent soln. in dimethylformamide (II) 0.47-0.51. The reactive NH(subscript 2) groups in I permitted Me acrylate (III) to be grafted onto it, whereas polyacrylonitrile was too inert to be used as a basis for the graft. The initiator for the grafting reaction was HVO(subscript 3) in H(subscript 2)SO(subscript 4) soln. Preliminary purification of III is done by distn. under Av. Typical conditions for the graft polymn. of III on Ia were: H(subscript2)SO(subscript 4) (1.5 moles/1.) HVO(Subscript 3) (0.04 moles/1.), vol ratio 50 to 1, 60 degrees, 1 hr., in a glass ampul under A and Ia increased in wt. by 10.80 percent. Control of the grafting was by increase in wt. and by N content. In the above example, the graft copolymer (IV) contained 22.25 percent N, which agreed well with the increase in wt. Durability is increased by 3 times by the grafting process. TAB

N70-18539# Washington Univ., St. Louis, Mo. Dept. of Chemistry.
THE CHEMISTRY AND UTILITY OF DIAZOALKANES Final Report, 1 Mar. 1968–28 Feb. 1969
C. David Gutsche 28 Feb. 1969 3 p refs
(Grant DA-ARO(D)-31-124-G533)
(AD-696502; AROD-4588-3-C) Avail: CFSTI CSCL 7/5

The report briefly summarizes a project concerned primarily with the synthetic utility of the diazoalkane-carbonyl reaction and with the synthetic utility of the products resulting from such reactions. Author (TAB)

N70-18541# Clarkson Coll. of Technology, Potsdam, N.Y.
PARAMAGNETIC PROPERTIES OF THE ALKALINE EARTH FLUORIDES Final Technical Report, 9 Apr. 1968-9 Jul. 1969
Raymond A. Jerway Oct. 1969 26 p refs
(Contract F30602-68-C-0300)
(AD-696180; RADC-TR-69-315) Avail: CFSTI CSCL 20/3

The results of a program concerned with the paramagnetic properties of the alkaline earth fluorides are summarized. A 3 cm wavelength electron spin resonance absorption spectrometer was constructed. The experimental portion of the program was mainly concerned with the investigation of the paramagnetic properties of isolated impurity ions in the alkaline earth fluorides as a function of temperature. In particular, the hyperfine coupling constants for Mn(2+) in CaF2 and SrF2 were measured over the temperature range 77 to 850K. In both cases the magnitude of the hyperfine coupling constant decreases with increasing temperature; and the temperature dependence is stronger for SrF2. The results have been interpreted using the Simanek-Orbach theory of a phonon-induced hyperfine field. Author (TAB)

N70-18551# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CHEMISTRY OF INORGANIC NITROGEN FLUORIDES
A. A. Pankratov et al 14 Mar. 1969 41 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Sibirskoye Otd., Izv., Ser. Khim. Nauk (USSR), no. 2, 1968 p 61-67
(AD-696302; FTD-HT-23-937-68) Avail: CFSTI CSCL 7/2

Contents: The chemistry of inorganic nitrogen fluorides; The physicochemical properties of inorganic nitrogen fluorides; The thermochemical and thermodynamic properties of inorganic nitrogen fluorides; The chemical properties of tetrafluorohydrazine; Nuclear magnetic resonance of 19F of chlorine pentafluoride; and A study of the reaction of dioxydifluoride with higher fluorides of some elements. TAB

N70-18553# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
MASS SPECTRA AND ANALYTICAL CORRELATIONS OF SOME ALKYLCYCLOALKYL SULFIDES
J. E. Dooley, R. F. Kendall, and D. E. Hirsch Feb. 1970 22 p refs
(BM-RI-7351) Avail: Issuing Activity

Reference mass spectra and analytical correlations for 20 alkylcycloalkyl sulfides and two dicycloalkyl sulfides are presented to provide information that will facilitate the identification of sulfur compounds occurring in natural or synthetic mixtures. Reference spectra indicate relative intensities in addition to parent and base peak sensitivities. Analytical correlations establish the ionic species that reflect major fragmentation paths for the compounds studied. Specifically, the correlations show that base peaks are formed by several different processes: cleavage of the bond alpha to the ring, fragmentation of the alkyl chain, and fragmentation of the ring plus fragment contribution from the alkyl chain. Other important ionic species are also discussed. Author

N70-18651# Avco-Everett Research Lab., Everett, Mass.
PLURAL AND MULTIPLE SCATTERING OF FAST ELECTRONS IN GASES
R. E. Center Jul. 1969 40 p refs Prepared for Bell Telephone Labs.
(Contract DA-30-069-AMC-333(Y))
(AD-696470; RR-329) Avail: CFSTI CSCL 7/4

The scattering of fast electrons in nitrogen and argon has been investigated under conditions resulting in approximately 1 to 100 small angle scattering collisions. Experimental measurements have been made of the spatial distribution of the scattered electrons for highly collimated incident electron beams. Electron energies of 20, 40 and 100 keV and gas target thickness of 3 to 1000 torr-cm at room temperature were used. The experimental distributions are much wider than predicted for single scattering and were approximately Gaussian for thick targets with many electron collisions. The dependence of the measured half current beam width on the target thickness varied from a 3/2 power law at small target thicknesses to a 1/2 power law in thick targets. Direct analog Monte Carlo calculations have been made based on a screened cross-section including the large contribution by inelastic collisions at very small scattering angles. Despite the approximate nature of the cross-section data the calculated spatial distributions of scattered electrons agree well with the experimental results except at the smallest target thicknesses where the calculated distributions are wider than the experimental results. Author (TAB)

N70-18709# National Bureau of Standards, Washington, D.C. Inst. of Materials Research.
ION-SELECTIVE ELECTRODES
Richard A. Durst, ed. Nov. 1969 475 p refs Conf. held at Gaithersburg, Md., 30–31 Jan. 1969
(NBS-SP-314) Avail: SOD $3.50

CONTENTS:

1. THEORY OF MEMBRANE ELECTRODE POTENTIALS: AN EXAMINATION OF THE PARAMETERS DETERMINING THE SELECTIVITY OF SOLID AND LIQUID ION EXCHANGERS AND OF NEUTRAL ION-SEQUESTERING MOLECULES G. Eisenman (California Univ., Los Angeles.) p 1–56 refs (See N70-18710 07-06)

2. SOLID-STATE AND LIQUID MEMBRANE ION-SELECTIVE ELECTRODES J. W. Ross, Jr. (Orion Research, Inc., Cambridge, Mass.) p 57–88 refs (See N70-18711 07-06)

3. HETEROGENEOUS MEMBRANE ELECTRODES A. K. Covington (Newcastle Univ. (England)) p 89–106 refs (See N70-18712 07-06)

4. REFERENCE ELECTRODES A. K. Covington (Newcastle Univ. (England)) p 107–141 refs (See N70-18713 07-06)

5. THERMODYNAMIC STUDIES J. N. Butler (Tyco Labs., Inc., Waltham, Mass.) p 143–189 refs (See N70-18714 07-06)

6. ACTIVITY STANDARDS FOR ION-SELECTIVE ELECTRODES R. G. Bates and M. Alfenaar p 191–214 refs (See N70-18715 07-06)

7. STUDIES WITH ION-EXCHANGE CALCIUM ELECTRODES IN BIOLOGICAL FLUIDS: SOME APPLICATIONS IN BIOMEDICAL RESEARCH AND CLINICAL MEDICINE E. W. Moore (Tufts Univ., Boston, Mass.) p 215–285 refs (See N70-18716 07-04)

8. ION-SELECTIVE ELECTRODES IN BIOMEDICAL RESEARCH R. N. Khuri (Am. Univ., Beirut (Lebanon).) p 287–312 refs (See N70-18717 07-04)

9. ANALYTICAL STUDIES ON ION-SELECTIVE MEMBRANE ELECTRODES G. A. Rechnitz (State Univ. of New York at Buffalo.) p 313–348 refs (See N70-18718 07-06)

10. INDUSTRIAL ANALYSIS AND CONTROL WITH ION-SELECTIVE ELECTRODES T. S. Light (Foxboro Co., Mass.) p 349–374 refs (See N70-18719 07-06)

11. ANALYTICAL TECHNIQUES AND APPLICATIONS OF ION-SELECTIVE ELECTRODES R. A. Durst p 375–414 refs (See N70-18720 07-06)

12. SYMPOSIUM DISCUSSION p 415–436

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N70-18710# California Univ., Los Angeles. Dept. of Physiology.
THEORY OF MEMBRANE ELECTRODE POTENTIALS: AN EXAMINATION OF THE PARAMETERS DETERMINING THE SELECTIVITY OF SOLID AND LIQUID ION EXCHANGERS AND OF NEUTRAL ION-SEQUESTERING MOLECULES
George Eisenman *In* NBS Ion-Selective Electrodes Nov. 1969 p 1–56 refs (See N70-18709 07-06)
(Grants NSF GB-4039; NSF GB-6685; NIH GM-14404-01-02-03) Avail: SOD $3.50

The principle theoretical expectations from the analysis of the origin of the membrane potential for each of the three types of electrodes are summarized. The parameters determining the ionic selection selectivity are explicitly examined. The similarities and differences between the mechanisms as well as their particular advantages and limitations are discussed. Only monovalent cations are considered, as a parallel line of argument applies in the case of monovalent anions. Derivation of the equations for the membrane potential at zero current are also given. Author

N70-18711# Orion Research, Inc., Cambridge, Mass.
SOLID-STATE AND LIQUID MEMBRANE ION-SELECTIVE ELECTRODES
James W. Ross, Jr. *In* NBS Ion-Selective Electrodes Nov. 1969 p 57–88 refs (See N70-18709 07-06)
Avail: SOD $3.50

Research directed toward developing useful new ion-sensing devices is summarized. Liquid membrane electrode systems are discussed, emphasizing ion-site salts derived from diesters of phosphoric acid. The positive ion effects on calcium ion activity is described. It is pointed out that selectivity with liquid membrane electrodes depends on the ion exchange process and the selectivity of solid state crystal membrane electrode depends on restricting the movement of all ions except the one to be detected. Solid state membranes considered are rare earth fluoride membranes and silver sulfide systems with other silver compounds or metal sulfides. N.E.N.

N70-18712# Newcastle Univ. (England). Dept. of Physical Chemistry.
HETEROGENEOUS MEMBRANE ELECTRODES
Arthur K. Covington *In* NBS Ion-Selective Electrodes Nov. 1969 p 89–106 refs (See N70-18709 07-06)
Avail: SOD $3.50

The development and characteristics of heterogeneous membrane electrodes are described. The inert binder material, used to form the membrane and give it the required mechanical properties, must be chemically inert and provide adhesion properties with the particles. Ion exchange resins and precipitate type membranes are discussed, and the properties of the precipitate types are tabulated. The most important properties are identified as grain size, crystalline form, precipitation properties, and solubility product. Details are presented on the characteristics, selectivity, and selectivity constants of silver halide electrodes. Sulfate, phosphate, sulfide, and fluoride electrodes are also described. N.E.N.

N70-18713# Newcastle Univ. (England). Dept. of Physical Chemistry.
REFERENCE ELECTRODES
Arthur K. Covington *In* NBS Ion-Selective Electrodes Nov. 1969 p 107–141 refs (See N70-18709 07-06)
Avail: SOD $3.50

The preparation, properties, and applications of reference electrodes are discussed. The uses of reference electrodes for ion selection, for direct comparison with an ion selective electrode supposedly reversible to the same ionic species, as electrodes reversible to another ion with an inert electrolyte added, and as bridging electrodes are described. Details are given on the preparation of hydrogen gas, silver–silver halide, mercury-mercurous chloride, mercury-mercurous sulfate, mercury-mercurous carboxylate, and thallium amalgam-thallous chloride electrodes. Methods of reducing liquid junction potentials are outlined, and temperature effects and pH values are considered. N.E.N.

N70-18714# Tyco Labs., Inc., Waltham, Mass.
THERMODYNAMIC STUDIES
James N. Butler *In* NBS Ion-Selective Electrodes Nov. 1969 p 143–189 refs Sponsored in part by US Dept. of Interior (See N70-18709 07-06)
Avail: SOD $3.50

Solid state and liquid ion exchange membranes and their uses are discussed. Details are presented on the lanthanum fluoride electrode with respect to its selectivity, stability, kinetic response, acidity effects, deviations from the Nernst equation, equilibria of the fluoride ion with the hydrogen ion, and activity coefficient measurements. The silver sulfide membrane electrode, calcium-selective electrodes and other solid state and liquid ion exchange electrodes are also considered. It is felt that the ion exchange electrodes, which are more or less specific for certain ions, have expanded enormously the scope of experimental and thermodynamic measurements in aqueous solutions. N.E.N.

N70-18715# National Bureau of Standards, Washington, D.C. Div. of Analytical Chemistry.
ACTIVITY STANDARDS FOR ION-SELECTIVE ELECTRODES
Roger G. Bates and Marinus Alfenaar *In its* Ion-Selective Electrodes Nov. 1969 p 191–214 refs Sponsored in part by Foxboro Co. (See N70-18709 07-06)
Avail: SOD $3.50

Standards and measurements of constants of ionic activity, acidity functions, pH values, and pA values are presented. Expressions are given for the pA values for cations and anions, based on the pA of a standard solution and the emf difference between the unknown solution and the standard solution. The use of pH values for standards is described, and values of the paA constants based on the pH, MacInnes, and Debye-Huckel conventions are compared. The problem of internal consistency in the application of the pH convention is also considered. Experimental and defined values of pA are given, and the limitations of practical pA measurements are identified. N.E.N.

N70-18718# State Univ. of New York at Buffalo. Dept. of Chemistry.
ANALYTICAL STUDIES ON ION-SELECTIVE MEMBRANE ELECTRODES
Garry A. Rechnitz *In* NBS Ion-Selective Electrodes Nov. 1969 p 313–348 refs (See N70-18709 07-06)
Avail: SOD $3.50

The range of analytical studies and uses of electrodes in biochemistry and in equilibrium and kinetic solution chemistry are reviewed, and problems regarding the electrode operation are discussed. Emphasis is placed on the ability of the ion-selective electrodes to measure the activity of ions in complexes and other associated chemical species. Early work in applying electrodes in chemical analyses and biochemical studies of reaction rates and mechanisms are discussed. Data are tabulated on atom and ion concentrations, formation constants, titration, solubility product constants, rate constants, and formation rates. Tables are also included of measurements by direct potentiometry and potentiometric titrations. N.E.N.

N70-18719# Foxboro Co., Mass.
INDUSTRIAL ANALYSIS AND CONTROL WITH ION-SELECTIVE ELECTRODES
Truman S. Light *In* NBS Ion-Selective Electrodes Nov. 1969 p 349–374 refs (See N70-18709 07-06)
Avail: SOD $3.50

The principles and operation of ion selective electrodes related to their use in industrial analytical instrumentation are discussed. A list is given of commercially available glass, solid state, and liquid ion exchange electrodes with their principal interferences. Modifications to the Nernst equation are presented to take into account the selectivity coefficient, temperature coefficients, measurement accuracy total ion concentration and ion activity, and concentration of a high ionic strength medium. Commercial applications are described for pH monitoring, water supply, and paper and pulp industry, and methods are also given for compensating for the electrodes not selective to the desired ion and for analysis of ions for which electrodes are not yet known. N.E.N.

N70-18720# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
ANALYTICAL TECHNIQUES AND APPLICATIONS OF ION-SELECTIVE ELECTRODES
Richard A. Durst *In its* Ion-Selective Electrodes Nov. 1969 p 375–414 refs (See N70-18709 07-06)
Avail: SOD $3.50

The techniques of direct potentiometric measurements and potentiometric titration applied to unusual types of laboratory analyses are described. The concentration cell techniques and calibration for the direct potentiometric method are discussed, and the method of standard additions is recommended. It is considered that direct potentiometric offers a means of rapid analysis and can be applied to almost unlimited variety of systems. On the other hand, it is felt that potentiometric titrations generally offer an increase in accuracy and precision over the direct potentiometric methods, but at a cost of increased time and difficulty. The critical problem in titration is the identification of the equivalence point. The fluoride and calcium selecting electrodes are first and second most important electrodes, respectively, and others are mentioned for selecting nitrate, tetrafluoroborate, perchlorate, halide, cyanide, silver sulfide, divalent cations, cupric, lead, and cadmium, sulfate and phosphate, and thiocyanate ions. N.E.N.

N70-18723 National Lending Library for Science and Technology, Boston Spa (England).
CONSTRUCTION OF A MATHEMATICAL MODEL OF CONTINUOUS PROCESSES FROM RESULTS OF BATCH-CONDITION STUDIES
A. G. Dyachko 21 Aug. 1969 34 p refs Transl. into ENGLISH from SB Nauchn. Tr., Gos. Nauchn.-Issled. Inst. Tsvet. Metal. (Moscow), No. 21, 1964 p 109-130 In RUSSIAN and ENGLISH (NLL-Trans-746-256-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .3 NLL photocopy coupons

Construction of a mathematical model for mass exchange in a continuous, heterogeneous process is described. Results of a study of chemical-reaction kinetics under periodic conditions are also discussed. Author

N70-18724 Case Western Reserve Univ., Cleveland, Ohio.
NITROPHENYLSULFONOXYLATION OF SUBSTITUTED BENZENES
Warren Russell Knipple (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-9412

Isomer distributions and relative reactivities with respect to benzene were determined for the *m*-nitrophenylsulfonoxylation of anisole, bromobenzene, methyl benzoate, and nitrobenzene. The relative reactivities of the most reactive (anisole) and the least reactive substrate (nitrobenzene) differ by about 4 million. For the reaction of m-nitrobenzenesulfonyl peroxide with substituted aromatic compounds a correlation was established, and a rho value of -4.75 was determined. Both the magnitude and the negative value for the reaction constant are consistent with the classification of this reaction as an electrophilic substitution. By following the disappearance of m-nitrobenzenesulfonyl peroxide in a substitution reaction as a function of time, the kinetics were determined in ethyl acetate solution for the m-nitrophenylsulfonoxylation of benzene, bromobenzene, methyl benzoate, anisole and mesitylene. Dissert. Abstr.

N70-18740# Pennsylvania State Univ., University Park. Dept. of Physics.
FIELD EVAPORATION RATES OF TUNGSTEN
Tien Tzou Tsong and Erwin W. Mueller 17 Nov. 1969 49 p refs
(Contract N00014-67-A-0385)
(AD-697280; TR-1) Avail: CFSTI CSCL 7/4

Essential parameters of the theory of field evaporation are the higher ionization potentials of the metal, the surface atoms distance from the effective electronic surface plane of the metal, the polarizability of the surface atom in its site, the energy difference between the atomic and the ionic states of the surface atom, the rate and temperature dependent activation energy, and the pre-exponential factor of the Arrhenius equation. It is shown how these data can be obtained from field evaporation rate measurements. Experiments with the (110) plane of tungsten were carried out in a range from 0.01 layer/sec to 10,000,000 layers/sec using both DC and pulsed field evaporation techniques. Results are discussed. It is also shown that the well known reduction of the evaporation field by the imaging gas is to a considerable extent due to the field induced adsorption of the gas. Author (TAB)

N70-18750 Louisiana State Univ., New Orleans.
CRYSTAL AND MOLECULAR STRUCTURES OF SELECTED NITROGEN HETEROCYCLIC COMPOUNDS
Richard John Majeste (Ph.D. Thesis) 1968 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-9315

The crystal and molecular structure of cis-13, 13-dimethyl-13-azoniabicyclo[10.1.0]tridecane iodide has been determined by a three dimensional single crystal, X-ray diffraction study. A final value of R = 0.11 was obtained for the 557 independent reflections which were observed. The crystal and molecular structure of 8-azaestrone hydrobromide was determined by a single crystal, X-ray diffraction study. When compared to the natural product, estrone, there are no statistically significant differences in the bond distances, bond angles, or overall configuration, offering no stereochemical explanation for its lack of estrogenic activity. A final value of R = 0.09 was obtained for the 1422 independent reflections evaluated by use of an integrating microdensitometer. The crystal and molecular structure of 1-azabicyclo-[3.2.0]-heptane-1-methylchloride has been determined by a single crystal X-ray diffraction study. A final value of R = 0.11 for the 305 independent reflections was obtained. Dissert. Abstr.

N70-18752 Utah State Univ., Logan.
THE OXIDATION OF HYDRAZINE BY MOLYBDENUM (VI) AND METHYLENE BLUE
Tracy Jau-hua Huang (Ph.D. Thesis) 1968 286 p
Avail: Univ. Microfilms: HC $12.85/Microfilm $3.65 Order No. 69-10111

The kinetics and mechanism of the molybdate catalyzed oxidation of hydrazine by methylene blue was studied from the individual investigations of the oxidation of hydrazine by Mo(VI) and the reduction of methylene blue by Mo(V)2. These reactions were studied anaerobically in 1 M phosphate buffer over a wide range of pH. For the oxidation of hydrazine by Mo(VI), molecular nitrogen is the only product derived from hydrazine. The order of reaction was determined to be second order, first order with respect to N2H5(+), and first order with respect to Mo(VI). A slight negative salt effect was observed at pH 1.6 while a large positive salt effect was observed at Ph 7.35. Rate studies were made at different pH values ranging from 1.2 to 7.8. Mechanisms were proposed and finally supported by a quantitative EPR analysis together with a mathematics treatment. The reaction of Mo(V)2 with methylene blue is first order in Mo(V)2 and zero order in methylene blue. The rate is independent of H(+). Dissert. Abstr.

N70-18789*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
SLUSH AND SUBCOOLED METHANE CHARACTERIZATION
C. F. Sindt, P. R. Ludtke, H. M. Roder, and N. A. Olien 14 Aug. 1969 24 p refs
(NASA Order R-06-006-003)
(NASA-CR-108129; NBS-9738) Avail: CFSTI CSCL 07D

Methane gas of 99 percent purity was condensed to liquid methane, and slush was subsequently produced using the freeze-thaw method. An apparatus was assembled which allows solid particles to be photographed in triple-point liquid with a reference grid in the background. Fresh and aged solid particles were photographed. Photos of the particles indicate a definite aging effect between fresh and 4-hour-old particles. Particles of two different size ranges appeared during the production process. Bibliographies on methane and methane mixtures were compiled. A tabulation of the areas where thermodynamic properties for methane are available was prepared from the bibliography and is presented. The table is supplemented with a skeletal temperature-entropy diagram showing the regions where insufficient property data are available. Author

N70-18794 Case Western Reserve Univ., Cleveland, Ohio.
THERMODYNAMIC PROPERTIES OF PHOSPHORYL FLUORIDE FROM 12 K TO 240 K. ITS ENTROPY FROM MOLECULAR AND SPECTROSCOPIC DATA. 1. THERMODYNAMIC PROPERTIES OF NITROGEN-ARGON SOLUTIONS. THE SOLID STATE TRANSITION. 2
Bernhardt Earl Jepson (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9410

A study of the thermodynamic properties of phosphoryl fluoride was undertaken to investigate the possible existence of randomness in the crystal at 0 K. Sufficient thermodynamic data were obtained to calculate the calorimetric standard entropy of the vapor and this value was compared to the value obtained from spectroscopic and molecular data. The thermodynamic properties of nitrogen rich argon-nitrogen mixtures were studied to investigate the effect of dilution with argon upon the solid–solid transition in pure nitrogen. Four mixtures consisting of 70%N2, 83%N2, 90%N2, and 94%N2 were studied calorimetrically. Heat capacities, heats of transition and fusion were observed. Solid–solid transitions were observed in all four mixtures. In the 70%N2 mixture a transition occurred over the temperature range 10 K to 22 K. The excess heat capacities were evaluated and the 83% mixture, a eutectic mixture, was found to have an unusually high excess heat capacity below the transition temperature. Dissert. Abstr.

N70-18814 Wisconsin Univ., Madison.
MOESSBAUER STUDIES OF IRON IN GLAUCONITE
Robert Allen Arnott (Ph.D. Thesis) 1968 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-867

The technique of Mössbauer spectroscopy was employed to gain information on the environmental and oxidational state of iron in glauconite, an iron rich, dioctahedral clay mineral of the illite group. The nine glauconite samples analyzed varied in composition from the end-mineral Bonne Terre and Franconia formations of Missouri and Wisconsin to the iron rich, potassium depleted samples from the Gilbert, Auburn, and Rouchleau mines in the Biwabic iron formation of Minnesota. Both ferrous and ferric iron were observed in at least one site of varying distortion or interaction in the octahedral sheet for all of the samples. The amount of distortion of environment was found to be larger for ferrous iron in the mine samples, compared to the end-member samples. The opposite was observed for ferric iron. There appears to be some correlation between the amount of environmental distortion and location of the iron atoms with the amounts of iron and interlayer cations present. Dissert. Abstr.

N70-18815 Cornell Univ., Ithaca, N.Y.
EXPERIMENTAL CLOSED LOOP CONTROL OF A DISTILLATION COLUMN
Malcolm Charles Beaverstock (Ph.D. Thesis) 1968 228 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-8837

The purpose is to compare closed loop experimental results with those predicted by a linear model. To carry out the objective, a fifteen plate 12 inch diameter distillation tower was constructed. A methanol-water mixture was separated continuously and closed loop feedback control was used. The top five plates were available as control points and the reflux flow to the column was the manipulated variable. Composition was continuously measured by a differential vapor pressure transmitter. Experimental results showed the maximum gain and critical frequency increased nearly four fold by moving the control point from plate 11 to plate 15 (top plate). The result of introducing ten percent load changes in feed composition, feed rate, and vapor rate demonstrated that the feedback control system could maintain control plate composition to within 0.0035 mole fraction deviation from the set point. The experimental tests were repeated using an analog simulation of the control system. The simulation predicted the critical frequencies within 10 percent and the maximum gain deviated by an average of 20 percent. Dissert. Abstr.

N70-18816 Maryland Univ., College Park.
PASSIVATION STUDIES OF THE ZINC ELECTRODE IN ALKALINE SOLUTIONS
Daniel Philip Boyd (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-9321

The zinc electrode was studied in an alkaline electrolyte media, and a passivation mechanism was advanced utilizing galvanostatic, potentiostatic and ellipsometric experimental techniques. The limiting and passivating currents were measured at temperatures of -40 to 30 C and at sweep rates of 0.2 to 22 volts/min. and this data demonstrated mass transfer dependence of the electrode. Addition definitive experiments were performed utilizing different KOH concentrations, and electrode structures. Passivation occurred quickly when a rearrangement of the reaction products on the surface of the electrode resulted in the formation of a transport current blocking film. Zinc ions diffused through this film and reacted with the hydroxyl ions in solution to produce the passivation currents observed. Dissert. Abstr.

N70-18817# Army Weapons Command, Rock Island, Ill. Science and Technology Lab.
DEVELOPMENT OF MULTIPLE ADSORPTION-GROUP CORROSION INHIBITORS: PRELIMINARY RESULTS OF THE SYNTHESIS OF POLY(BETA-ALKYL-P-STYRENE SULFONATE) SALTS
Ferrel E. Anderson Jun. 1969 32 p refs
(Contract DA-1-G-062105-A-109)
(AD-696479; TR-69-111) CSCL 7/3

A literature search for studies of surface adsorption, stereo-chemistry, and synthesis chemistry was conducted to determine molecular structural designs and synthesis reaction series for oil soluble, polymeric, multiple-adsorption-group corrosion inhibitors. The most promising compounds of this type were considered to be linear beta-alkyl substituted polystyrenes and ethylene or propylene beta-alkyl substituted polystyrene copolymers with para substituted polar adsorption groups. A trial reaction series involving the synthesis of barium, calcium, and potassium poly (beta-hexadecyl-p-styrene sulfonate) salts was completed. In the trial synthesis, the final product was a mixture of the saturated monomer and dimer of beta-hexadecyl styrene having three sulfonate groups. The position of the sulfonate groups was not determined. It was concluded that the synthesis reaction series was sound, but that minor alterations would have to be made in the polymerization and sulfonation reaction steps before subsequent synthesis could be successful in yielding high molecular weight, linear polymer chains with sulfonation in the para position. Author (TAB)

N70-18819 Cornell Univ., Ithaca, N.Y.
STUDIES OF THE ELECTRON SPIN RELAXATION TIMES OF THE BENZENE, TETRACYANOETHYLENE, AND PEROXYLAMINE DISULFONATE ANION RADICALS IN SOLUTION AND THE CHARACTERIZATION OF THE CORONENE CATION DIMER
Robert Galen Kooser (Ph.D. Thesis) 1968 214 p
Avail: Univ. Microfilms: HC $9.70/Microfilm $3.00 Order No. 69-8834

To better understand the electron-spin relaxation mechanisms of free radicals in solution, the transverse (T2) and longitudinal (T1) electron-spin relaxation times of the benzene anion, the tetracyanoethylene anion, and the peroxylamine disulfonate dianion were determined under a variety of experimental conditions. The technique of continuous saturation was used to obtain the values. Refinements of the technique were done in order to take in account: (1) nonuniform microwave and d.c. modulation fields over the sample length, (2) changes in the cavity Q with changing temperature of the sample, and (3) distortions of the microwave field from the dielectric media surrounding the sample. Application of these corrections allow the determination of the absolute T1/T2 ratio to better than + or - 20%. The details for measuring the microwave field strength by the method of perturbing spheres are presented. The theoretical development for rotary saturation in solutions is given and it is shown that this could also be used to measure the microwave field. Dissert. Abstr.

N70-18820 Saskatchewan Univ., Saskatoon.
PHOTOLYSIS OF ALKANETHIOLS
Ronald Paul Steer (Ph.D. Thesis) 1968 239 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-9311

The photolysis of methanethiol and ethanethiol in the vapor phase was studied. The effects of varying the exposure time, temperature, light intensity and substrate pressure and the effects of adding inert deactivating gases, nitric oxide and ethylene were examined. The influence of inert gas pressure, temperature and photolysis wavelength on the photochemical addition of the thiols to ethylene was also investigated. Evidence was obtained which indicates that the only significant primary process in the photolysis of these two thiols is S-H bond cleavage and that the sole fate of the hydrogen atom produced is the abstraction of the sulfhydryl hydrogen of the substrate to form molecular hydrogen and a thiyl radical. The quantum yield of hydrogen formed by the reactions of hydrogen atoms is 1.0. Evidence for the formation of hot hydrogen atoms in the primary processes was also obtained. The only important reaction in which the thiyl radicals participate in the absence of reactive addends in combination to form excited disulfide molecules. Dissert. Abstr.

N70-18831 Iowa State Univ. of Science and Technology, Ames.
STEADY-STATE MEASUREMENTS OF DIFFUSION COEFFICIENTS IN THE LIQUID BISMUTH-TIN SYSTEM
Charles Henry Buel, Jr. (Ph.D. Thesis) 1968 53 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9847

The feasibility of accurately determining relative liquid metal diffusion coefficients by a constant flux method was investigated. The diffusion coefficients were found as a function of concentration at 300, 340, and 400 C. The diffusion coefficients relative to 50% bismuth were described in terms of fourth degree equations with standard deviations of 3.5% or less. The absolute values of the diffusion coefficients were determined from the capillary cell method, using the resistivity technique of concentration analysis. An error analysis of the input data indicated that the accuracy of the diffusion coefficients was within + or - 10%. Dissert. Abstr.

N70-18833 Iowa State Univ. of Science and Technology, Ames.
ELECTRICAL DOUBLE LAYER STRUCTURE IN THE PRESENCE OF ADSORBED ORGANIC MOLECULES
David Edward Broadhead (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-9846

The adsorption of chloroform, 3-pentanol, cyclohexanol and cyclohexanone at the mercury-0.1N perchloric acid solution interface has been studied. Interfacial tension measurements were made with a capillary electrometer of greatly improved precision. In the analysis of the electrocapillary data obtained for each adsorbate it was discovered that the surface pressure - in activity curves for different potentials could be superimposed by a translation along the ln a axis. Implications of this superimposability are (1) that the interactions between molecules of the adsorbate are independent of the electrical state of the interface and (2) that the surface charge density varies linearly with surface excess (at fixed potential). Dissert. Abstr.

N70-18836 Pennsylvania State Univ., University Park.
PHASE EQUILIBRIA OF PARTIALLY MISCIBLE MIXTURES OF HYDROCARBONS AND WATER
Samuel Dare Burd, Jr. (Ph.D. Thesis) 1968 209 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-9745

The need for accurate vapor-liquid equilibrium data and

a reliable correlation to extend such data is self-evident when one considers the numerous industrial applications whose designs are dependent upon such equilibrium properties. For hydrocarbon-rich liquid mixtures containing water few data are available. The primary objective of this work was to define the vapor-liquid phase behavior of mixtures of the six-carbon hydrocarbons with water at temperatures from close to ambient and extending to the vicinity of cracking region, approximately 700F. A representative of each type of hydrocarbon, i.e., paraffin, olefin, naphthene and aromatic, was studied to determine the effect of molecular type on the vapor-liquid equilibrium. Data was correlated into a generalized and thermodynamically consistent framework. If such a generalized correlation should prove unobtainable, a more specific approach would be acceptable. Dissert. Abstr.

N70-18837 North Carolina Univ., Chapel Hill.
AN OPTICALLY TRANSPARENT THIN LAYER ELECTRODE, PART 1. SELECTIVE ELECTRODE INHIBITION BY AN ADSORBED ASYMMETRIC FILM, PART 2
William Richard Heineman (Ph.D. Thesis) 1968 134 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-10166

Electrochemical and spectral characteristics of visible, ultraviolet, and infrared optically transparent thin layer electrochemical cells which are fabricated about a gold minigrid electrode are described. The capability for rapid and simultaneous acquisition of coulometric and spectral data were demonstrated for this electrode. Cells combining the properties of large optical thickness with small diffusional thickness by use of multiple, spacer-separated gold minigrids were evaluated. The problem of potential gradients and uneven current distribution along the working electrode was partially alleviated by incorporating porous VYCOR glass into the cell. Application of various transparent electrodes to the electrochemistry of ninhydrin in acetonitrile was made. Ninhydrin was found to reduce in two one electron steps in this solvent. Dissert. Abstr.

N70-18838 Illinois Univ., Urbana.
PION-ELECTRON MODEL FOR METAL CARBONYLS, PART 1. INFRARED INTENSITIES OF THE CARBONYL STRETCHING MODES IN ARENECHROMIUM TRICARBONYLS, PART 2
Wayne Philpott Anderson (Ph.D. Thesis) 1968 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-10627

A molecular orbital model for octahedral transition metal carbonyl compounds, based on consideration of the pion-electronic system, was developed. Metal-ligand delta bonding is included as a fixed parameter. The effect of the donor and acceptor character on calculated equilibrium charge distributions, carbonyl force constants, and infrared intensities is studied. Calculated values are compared with experimental data for substituted group VI metal carbonyls reported in the literature. The agreement is good. The use of force constants and infrared intensities to deduce the nature of the M-L bonding is substituted metal carbonyls is examined. Particular emphasis is placed on charge redistribution during vibrations of the carbonyl groups. The various factors contributing to the intensity of the carbonyl bands in the infrared spectrum are studied as a function of L. Dissert. Abstr.

N70-18848# Atomic Weapons Research Establishment, Aldermaston (England).
THE MULTI-ELEMENT ANALYSIS OF GLASS FRAGMENTS BY NEUTRON ACTIVATION AND THE APPLICATION TO FORENSIC SCIENCE Interim Report
G. C. Goode, G. A. Wood, and R. F. Coleman Nov. 1969 33 p refs
(AWRE-O-54/69) Avail: HMSO 5s; BIS $1.00

Methods for the multi-element analysis of glass fragments using thermal neutron activation and gamma spectrometry are described. A representative collection of window glass samples from England and Wales has been obtained from scenes of fires and 200 of these analysed. A preliminary assessment of the discrimination of the technique for forensic examination is attempted and a comparison with physical methods made. Author

N70-18848 Iowa State Univ. of Science and Technology, Ames.
MOLECULAR STRUCTURE OF GASEOUS HYDROGEN FLUORIDE POLYMERS AND OF VAPORS OF THE STEEL COMPLEXES
Jay Janzen (Ph.D. Thesis) 1968 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-9865

Two experimental investigations of gas phase molecular structures by electron diffraction are described. Electron diffraction patterns with molecular interference features extending beyond s = 35 A to the minus one power were obtained for gaseous self-associated HF introduced under its own vapor pressure at +22 and at -19 C through a conventional nozzle system into a 40 kV electron beam. The diffraction patterns and their dependence on temperature are best explained with the hypothesis that the monomer and a cyclic hexamer were the only appreciable constituents of the scattering vapors. Of special note is the decided pucker required to account for the electron intensity diffracted by the hexameric rings. The experimental HF study is supplemented by a literature review on the physical properties and oligomerization of hydrogen fluoride vapor which refines and extends published analyses. No evidence for the existence in the gas phase of aggregate species of the sort NOF(HF)(n) was found in an examination of the vapors over materials reported to be new complexes. The liquids are instead azeotropes; the first contained only N2O3 and HF, in a mole ratio of 1 : 12.6; and other two NOF and HF with a trace of N2O3. Methods for analyzing electron diffraction data for mixed vapors were developed, and a general formalism is presented. Dissert. Abstr.

N70-18858 Saskatchewan Univ., Saskatoon.
THE ELECTRONIC STRUCTURES AND SPECTRA OF SOME COMPOUNDS CONTAINING CARBON DIOXIDE AND CARBON NITROGEN
Ilyas Absar (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9303

Suitable wave-functions are found for a complex molecule, so that its various electronic transition energies may be predicted. In order to investigate the several questions that arise in an application of the semi-empirical method to sigmaelectrons, we have carried out a series of studies on formaldehyde, a compound for which there are ultraviolet spectral data involving sigma, pi, and nun-bonding electrons. Our main objectives were to investigate: (1) the relative adequacy of the use of the theoretical and semi-empirically adjusted two centre Coulomb repulsion integrals in the extension to sigma-electron systems, of the method developed by Pariser, Parr and Pople for pi-electron systems; (2) the adequacy of theoretically computed penetration integrals in a semi-empirical calculation; (3) the effect of including the overlap correction to the diagonal matrix elements on computed electronic properties; and (4) the effect of including resonance integrals for non-adjacent atoms. Dissert. Abstr.

N70-18862# Wisconsin Univ., Madison.
MODIFICATION OF THE REACTIVITY OF SOME CARBOXYLIC ACID DERIVATIVES BY COMPLEXATION WITH XANTHINES: EFFECTS ON SOME INTERMOLECULAR AND INTRAMOLECULAR REACTIONS
Paul Alan Kramer (Ph.D. Thesis) 1968 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-945

Applications of the kinetic method were investigated by examining the effects of complexation on a variety of intermolecular and intramolecular reactions. Cinnamates or benzoates and xanthines were chosen as substrates and ligands, whenever possible. Reactions studied included the intramolecular general-base catalyzed

hydrolysis of trans-cinnamoylsalicylate ion at 50.0 deg; sulfite addition to the olefinic double bond of this compound at 25.0 deg, and intermolecular nucleophilic catalysis of its hydrolysis by imidazole at 25.0 deg; intermolecular nucleophilic reaction of hydroxylamine, hydroperoxide ion, hydrazine and sulfite dianiom with p-nitrophenyl benzoate at 25.0 deg; intermolecular general-base catalysis of N-trans-cinnamoylimidazole in its free and cationic forms by water and acetate at 25.0 deg; and the intramolecular nucleophilic catalysis of the hydrolyses of phthalamic acid (40.0), p-nitrophenyl glutarate (25.0 deg), and methyl hydrogen phthalate (98.0 deg). Dissert. Abstr.

N70-18869 Iowa State Univ. of Science and Technology, Ames.
ELECTROCHEMICAL REDUCTION OF ISOMERIC ORGANIC BROMIDES
Ronald Raymond Carlton (Ph.D. Thesis) 1968 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-9849

The electrochemical behavior of the geometric isomers, bromocitraconic acid and bromomesaconic acid, were investigated. The results were compared with the data for monobromomaleic acid and monobromofumaric acid. In addition, the polarographic behavior of the corresponding non-brominated geometric isomers has been studied to explore the characteristics of double bond reduction as it relates to carbon-bromine bond fission. Polarographic and coulometric data show that bromocitraconic acid and bromomesaconic acid undergo a one step four-electron reduction of the double bond and fission of the carbon-bromine bond. The differences in the electrochemical behavior between these two sets of bromo-isomers provided information on the magnitude of the electronic and steric effects of a methyl group compared to a hydrogen atom on the two reduction reactions. Variations in the half wave potentials and electron transfer coefficients indicate that a co-planar alignment of the unsaturated compounds with the electrode surface is the preferred orientation. Dissert. Abstr.

N70-18879 Georgia Inst. of Tech., Atlanta.
EARLY STAGES IN THE INTERACTION OF CARBON MONOXIDE WITH IRON SINGLE CRYSTAL FILMS
James Titus Ratliff (Ph.D. Thesis) 1968 416 p
Avail: Univ. Microfilms: HC $18.90/Microfilm $5.30 Order No. 69-9541

A literature survey is presented which includes the following subjects: metal dusting, emphasizing the CO attack of iron; single crystal film technology; and, preparations of iron single crystal films. The equipment and procedures developed for the *in situ* production and reaction of epitaxic iron single crystals are described. Electron microscopy was the technique chosen for iron surfaces are a sufficient catalyst for the decomposition of high purity carbon monoxide. The first solid product was established to be cementite which nucleates from carbon-rich atom clusters on dislocations and dislocation sub-boundaries. The activation energy for the growth of the cemetite precipitate particles was shown to be 21.4 kcal/mole corresponding well with the activation energy for the diffusion of carbon in alpha-iron. Graphite was found to nucleate as cementite begins to decompose. The solid phase reaction was characterized as a continuous precipitation process for which iron and graphite are the equilibrium phases. From the experimental data and the information given in the literature, a mechanism was proposed for the CO attack of iron. Dissert. Abstr.

N70-18880 California Univ., Berkeley.
INVESTIGATIONS OF THE TETRAHEDRAL INTERMEDIATE OF ACYL TRANSFER REACTIONS BY CARBONYL OXYGEN-18 EXCHANGE KINETICS
Sydney Alan Shain (Ph.D.Thesis) 1968 167 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-10382

The carbonyl-oxygen-18 content of methyl and ethyl benzoate; methyl and ethyl p-nitrobenzoate; methyl and ethyl p-aminobenzoate; and ethyl p-trifluoromethylbenzoate was monitored during the course of alkaline hydrolysis. No oxygen-18 depletion was observed for any of the three methyl benzoates for up to 85 percent completion of reaction in 33.3 percent dioxane-water. Additionally, no significant incorporation of solvent oxygen-18 occurred during the alkaline hydrolysis of methyl p-nitrobenzoate in 33.3 percent dioxane-oxygen-18 enriched water. Both methyl and ethyl benzoate exchange carbonyl-oxygen with solvent oxygen during the course of alkaline hydrolysis in the absence of added dioxane. All four ethyl benzoates underwent carbonyl-oxygen exchange with solvent oxygen during alkaline hydrolysis in 33.3 percent dioxane-water. The Hammett rho constants for the exchange and hydrolysis reactions of the ethyl benzoates in 33.3 percent dioxane-water were identical and had an approximate value of 2. Neither the exchange nor hydrolysis reaction of ethyl p-nitrobenzoate was subject to a primary deuterium isotope effect during reaction in 33.3 percent dioxane-deuterium oxide. Dissert. Abstr.

N70-18883 California Univ., Berkeley.
SOLUTE ATOM LOCKING OF DISLOCATIONS
Loren Arthur Jacobson (Ph.D. Thesis) 1968 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10315

Elastic strain interactions between solute atoms and edge dislocations result in atmospheres about the dislocation which differ in concentration from the average solute content. The atmosphere about a dislocation is formed by equilibration at high temperatures, where diffusion can take place. The atmosphere is immobile at low temperatures, therefore the dislocation is locked. Employing the above model, the stress required to free the dislocation in the absence of thermal activation is calculated for different average solute concentrations and equilibration temperatures. A model for the thermally activated escape of the dislocation is proposed, and the stress dependence of the activation energy is compared with other theoretical preductions. The predicted variation in the athermal breakaway stress with the temperature of equilibration for constant average concentration has not been previously tested. An experiment involving the breakaway of a low-angle tilt boundary is proposed to illuminate this point; the breakaway of an edge dislocation array is predicted to occur athermally. Dissert. Abstr.

N70-18884 Case Western Reserve Univ., Cleveland, Ohio.
INFRARED SPECTRA OF SOME TRANSITION METAL DIHALIDE MOLECULES
Kenneth Roy Thompson (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-9440

Gaseous molecules produced in the high temperature vaporization of condensed phase transition metal dihalides are known from mass spectrometric studies to be monomer and dimer species. The molecular constants, geometry, and electronic structure of these molecules were subjects of several experiments and discussions. Measurements of the infrared spectra of these molecules have detected only the asymmetric stretching frequency of the monomer and an unspecified mode of the dimer, but have given no definite conclusions on their geometries. It was inferred from a few electric deflection experiments that the monomers have linear structures, and measurements of their electronic spectra were interpreted on this basis. There were speculations that the dimer has a ring structure, but there are no experimental data to support this assumption. Dissert. Abstr.

N70-18888 Carnegie-Mellon Univ., Pittsburgh, Pa.
PRODUCTION AND DECORATION OF DISLOCATIONS, ANISOTROPY, AND NOISE IN SILICON
Li-heng Wu (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 68-17623

The purpose of the research on which this thesis is based was to study the effects of copper precipitate on the electrical properties of silicon, in particular, the electrical noise and mobility. The copper doped samples were prepared by copper diffusion. Cooling modes and dislocations were used to vary the relative

amount of dispersed copper and copper precipitate. The dislocations, presumed to act as the nucleation centers for precipitation, were introduced into the samples by plastic bending. An original approach to the form of the edge of the dislocation, under an applied stress field, is proposed. The optimum condition for producing a parallel array of dislocations is investigated experimentally and theoretically. Examination shows that the etch pit pattern for the dislocation after bending is consistent with the theoretical calculation.
Dissert. Abstr.

N70-18897 Princeton Univ., N.J.
KINETICS AND MECHANISM OF THE THERMAL DECOMPOSITION OF MOLTEN ANHYDROUS LITHIUM NITRITE
Augustine Kwok Kwun Lee (Ph.D. Thesis) 1968 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-10508

The thermal decomposition of anhydrous lithium nitrite has been studied at 250, 300, and 350 C using a semi-flow batch reactor. Kinetic curves of both the gas phase and the molten phase were obtained. The mechanism of the thermal decomposition of the nitrite may be represented by the following reaction steps: $2LiNO2 = Li2O + N2O3$; $N2O3 = NO + NO2$; $LiNO2 + N2O3 = LiNO3 + 2NO$; $2 LiNO2 + N2O3 = 2LiNO3 + N2O$; $Li2O + 2NO2 = LiNO2 + LiNO3$; $2LiNO2 + 2NO = 2LiNO3 + N2$; $2LiNO3 = 2LiNO2 + O2$. The overall stoichiometric equation of decomposition has been shown to be the sum of a combination of these individual reactions.
Dissert. Abstr.

N70-18902 Duke Univ., Durham, N.C.
A STUDY OF SOME COPPER(II)-AMINE-WATER SYSTEMS BY MEANS OF THE LONGITUDINAL AND THE TRANSVERSE NUCLEAR MAGNETIC RELAXATION TIMES
Charles Jay Nelson (Ph.D. Thesis) 1968 272 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 69-9069

The longitudinal (T1) and the transverse (T2) nuclear magnetic relaxation times of the water protons in aqueous solutions containing octahedral copper(II)-amine complexes of varied composition were investigated by pulsed NMR methods. The composition of the complex species was usually determined by the amount of added free ligand: 2,2'-bipyridine (bipy), ethylene-diamine (en), ammonia, methylamine, dimethylamine, and trimethylamine. Comparison of the magnetic parameters of solutions with and without the paramagnetic metal ion indicated that small amounts of dissolved copper(II) may substantially alter the T1, and T2 of water protons in the bulk of solution. The effect on the solvent T1 and T2 was found to result from direct contact of the solvent species with the metal ion followed by rapid molecular exchange into the bulk of solution and from rapid proton interchange between the solvent and other coordinating ligands possessing exchangeable protons.
Dissert. Abstr.

N70-18903 Catholic Univ. of America, Washington, D.C.
DIELECTRIC RELAXATION PROCESSES IN LIQUID NORMAL ALCOHOLS
Phi Thinh Duc (Ph.D. Thesis) 1968 64 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-9134

The dielectric properties of n-butanol were measured as a function of temperature from −40 to +40 C, and as a function of frequency from 1 MHz to 8.5 GHz. The results are combined with previous data from this laboratory for n-pentanol, n-hexanol, n-heptanol, n-octanol, and with published data to analyze the dielectric relaxation behavior of normal alcohols. The main relaxation at low frequencies is definitely of Debye type, i.e., it contains a single relaxation time. The data show that the form of the high frequency region of relaxation is less certain. The high frequency data have been analyzed by assuming two high frequency relaxation regions. However, error analysis of the data indicates that other possibilities may exist, i.e., a distribution of times may also be used to describe the high frequency portion of the spectrum. The temperature dependences of the relaxation times of the three relaxation processes are quite similar. Thus, the three processes have similar enthalpies of activation, and the mechanisms operative in these regions of relaxation are closely connected.
Dissert. Abstr.

N70-18916 Princeton Univ., N.J.
MEASUREMENT OF NORMAL STRESS DIFFERENCES IN POLYISOBUTYLENE SOLUTIONS
Richard Laird Hoffman (Ph.D. Thesis) 1968 133 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-10503

An axial annular flow system has been used to determine the secondary normal stress difference for a 6.1 weight percent solution of polyisobutylene in cetane. An approximate method has been developed for inverting the integral equation which characterizes the system. The error caused by the approximate solution is estimated by an equation which gives the upper bound on the error. The Ellis model was used to characterize the shear stress-shear rate behavior of the polyisobutylene-cetane solution over a shear rate range of 0.22 to 280/sec and the constants obtained for this model were used to calculate the position of the radius of zero shear. Gel permeation chromatography was used to measure the distribution of polymer molecular weight throughout the experimental runs, and the results indicate that normal stress difference is sensitive to changes in the distribution caused by shear degradation.
Dissert. Abstr.

N70-18917*# California Univ., Santa Cruz. Div. of Natural Sciences.
RADICAL STABILITIES IN NITROGEN CONTAINING HETEROCYCLIC SYSTEMS
E. M. Evleth 31 Dec. 1969 3 p
(Grant NGL-05-061-004)
(NASA-CR-108201) Avail: CFSTI CSCL 07C

The generating and measuring of neutral radicals of the molecules imidazole and benimidazole by chemical oxidation or reduction methods, photolysis, or electrolysis was attempted but as yet proved unsuccessful. Spin density calculations determined the charge densities (both alpha and beta electrons) and spin densities in both radicals; results showed that spin densities were not equal at all locations and that the nitrogen went negative.
G.G.

N70-18920*# State Univ. of New York, Stony Brook. College of Engineering.
THERMODYNAMIC PROPERTIES OF INTERSTITIAL ELEMENTS IN THE REFRACTORY METALS Progress Report, 1 Jun. – 30 Nov. 1969
D. K. Gupta, S. C. Srivastava, and L. Seigle 30 Nov. 1969 14 p refs
(Grant NGR-33-015-035)
(NASA-CR-108122; PR-7; PR-8) Avail: CFSTI CSCL 07D

Details of the experimental techniques for determining the activity of C in Mo and W at the solubility limit by measuring the vapor pressure of Ca over a mixture of Me, Me2C, and CaC2, and by measuring the electromagnetic force of a galvanic cell of the type Me + Me2C | CaCl2 + CaC2 | C are reviewed. It is concluded that the emf method would be simpler to apply, and work has been started to construct a cell. Work has also begun to obtain missing information about the solubility of oxygen in Mo by equilibrating Mo rods in a mixture of Mo + MoO2.
Author

N70-18931 National Lending Library for Science and Technology, Boston Spa (England).
ELECTROLYSIS OF WASTE SLAGS FROM A COPPER MELT WITH A MOLTEN COPPER CATHODE
G. Toporishchev et al Oct. 1969 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met. (Dzaudzhikau), no. 4, 1968 p 16–21

(NLL-RTS-5387) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

The composition of cathodic precipitate and the effect of current on the elements dissolved during the electrolysis of industrial slags were studied. Results were analyzed previously conducted tests on the electrolysis of waste slag at temperatures of 1080 to 1150 C, with and without current. It is concluded that: (1) Without electrical current, molten copper reacting with a liquid slag is enriched with iron, zinc, and sulfur and then separates into a metal and a sulfide base. There is virtually no precipitation of the matte beads suspended in the slag. (2) At low current density the trivalent iron in the slag is reduced at the cathode to bivalent iron, the copper and the matte are deoxidized, and copper, iron, and zinc are precipitated. (3) At greater current densities, copper and sulfur occur in the cathodic precipitation mainly as a result of the electro-capillary movement of the matte beads. In addition, iron is precipitated, mainly at 1080, and zinc at 1250 C. (4) After the current has been on for a short time, it is possible to extract practically all the copper from the slag in its solute and matte bead forms. D.L.G.

N70-18934 National Lending Library for Science and Technology, Boston Spa (England).

PHYSICO-CHEMICAL INVESTIGATION OF A BAO2-BASED OXIDE CATHODE IN FLUORESCENT LAMPS [FIZIKO-KHIMICHESKIE OSSLEDOVANIYA OKSIDNOGO KATODA NA OSNOVE BAO2 V LYUMINESTSENTNOI LAMPE]

D. S. Malysheva et al Oct. 1969 9 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), no. 3, 1968 p 6–8
(NLL-RTS-5352) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupons

The emissitivity and phase constitution of BaO2 cathode coatings were investigated and the gases given off when the BaO2 decomposes were analyzed. After measuring their emission in diodes, the BaO2-based cathodes were subjected to X-ray structural analysis. Forty specimens were examined under various temperatures. Specimens treated at 950 C (and either activated or not activated at 1200 C) consisted of Ba3WO6 and BaZrO3, but when the BaO2 was decomposed at 750 C without activation, neither Ba3WO6 nor BaZrO3 was detected. The experiments confirmed the feasibility of suppressing tungsten core oxidation and eliminating the formation of a Ba3WO6 interlayer, thus prolonging the life of the cathodes and reducing the life scatter. Author

N70-18936 National Lending Library for Science and Technology, Boston Spa (England).

METHOD OF DETERMINATION OF MONO-FURFURYLIDENE ACETONE IN AQUEOUS WASTE LIQUORS [METOD OPREDELENIYA MONOFURFURILDENATSETONA V STOCHNYKH VODAKH]

Yu. M. Mamatov et al Sep. 1969 7 p refs Transl. into ENGLISH from Gidrol. i Lesochich. Prom. (USSR), no. 2, 1969 p 9–10
(NLL-RTS-5322) Avail: Natl. Lending Library, Boston Spa, Engl.: 5s or 1 NLL photocopy coupons

A colorimetric and bromination method is described for the quantitative determination of mono-furfurylidene acetone (MFA) in aqueous solutions in the presence of furfural. A sample of the aqueous liquor containing up to 5mg (5ml) of the substances being brominated was withdrawn using a pipette and transferred to a 300ml conical flask with a ground glass stopper. Bromide-bromate mixture(25ml) and hydrochloric acid(10ml) were added. The flask was stoppered, carefully agitated and left for 4 hours in the dark for bromination to take place. After this, 15ml potassium iodide and 150ml distilled water were poured into the flask. The iodine liberated was titrated against 0.1 N sodium thiosulphate solution in the presence of starch. The furfural content in the aqueous waste liquor was determined in a photoelectric-colorimeter prior to bromination. The MFA content in the sample as calculated by a given formula. The results show that in the aqueous waste liquor from the production of the monomer FA, 0.2 to 1.5% MFA and 0.05 to 1.5% furfural is present. E.M.C.

N70-18943 California Univ., Berkeley.

THE HYDRATES OF SODIUM HYDROXIDE: THEIR THERMODYNAMIC PROPERTIES AT 298.15 K. ENTROPIES OF NaOH·2H2O AND NaOH·3.5H2O FROM THEIR LOW TEMPERATURE HEAT CAPACITIES

Paul Rodney Siemens (Ph.D. Thesis) 1968 41 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10384

The heat capacity of NaOH·2H2O was measured from 12 to 340 K and of NaOH·3.5H2O from 12 to 300 K. The heat of fusion of NaOH·2H2O is 3859 cal/mole at its unstable melting point, 286.5 K. The NaOH·H2O-NaOH·2H2O solution peritectic temperature is 285.73 K. To be compared, is the entropy of NaOH·2H2O, at 298.15 K calculated from the available heat and free energy data, and Murch and Giauque's entropy of NaOH·H2O(s). From the reaction NaOH·H2O(s) + H2O(1) = NaOH·2H2O; S(NaOH·2H2O) = S(NaOH·H2O) + S(H2O(1) + (ΔH – ΔF)/T = 46.85 gibbs/mole. For NaOH·3.5H2O, the heat of fusion is 5380 cal/mole at its melting point, 288.53 K. A calculation for NaOH·3.5H2O similar to that for NaOH·2H2O gives the entropy at 298.15 K as 68.44 gibbs/mole. Tables of the thermodynamic properties of NaOH·2H2O (10 to 350 K) and NaOH·3.5H2O (10 to 330 K) were prepared. The entropies of NaOH·3H2O, NaOH·4H2O, NaOH·5H2O and NaOH·7H2O at 298.15 K, derived from the entropy of NaOH·H2O with ΔS = (ΔH – ΔF)/T, are also given. Dissert. Abstr.

N70-18947 National Lending Library for Science and Technology, Boston Spa (England).

VACUUM REMOVAL OF SULPHUR FROM MOLTEN NICKEL

V. Rikhling et al 21 Aug. 1969 6 p refs Transl. into ENGLISH from Fiz.-Khim. Osnovy Proizv. Stali, Akad. Nauk SSSR, Inst. Met., Tr. 6-oi Konf. (Moscow), 1964 p 354–357 In RUSSIAN and ENGLISH
(NLL-Trans-746-273-(9022.40)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The possibility of removing sulfur from nickel and the rate of removal are investigated. Melting was carried out in a vacuum induction furnace with a residual pressure of about 0.01 mm Hg. The experiments show that the sulfur can be removed only if oxygen is present in the molten metal. The higher the oxygen concentration in the metal, the faster and more completely the removal process takes place. R.B.

N70-18951# Ballistic Research Labs., Aberdeen Proving Ground, Md.

THE VAPOR PHASE REACTIONS OF DIBORANE WITH ACETONE

Lester P. Kuhn and J. Omar Doali Sep. 1969 28 p refs
(AD-697150; BRL-1451) Avail: CFSTI CSCL 7/2

The kinetics of the gas phase reaction, B2H6 + a(CH3)2 C=O yielding 2HB(i-prO)2, was studied. The reaction was found to be homogeneous, first order in diborane, and first order in acetone. The second order rate constant is given. The reaction is catalyzed by ethyl ether and tetrahydrofuran. The catalyzed reaction is first order in ligand, first order in diborane, and zero order in acetone. Its second order rate constant is also given. The data suggest that diborane and the ligand react reversibly to form a 1:1 complex in which both bridged B-H bonds remain intact. The complex then rearranges slowly in a rate determining step to form a second complex in which one of the bridged B-H bonds is broken. The second complex reacts with acetone in a series of rapid steps to form diisopropoxyborane. Consistent with this hypothesis is the observation that cyclobutanone is reduced by diborane in the uncatalyzed reaction at a slower rate than acetone and in the catalyzed reaction at the same rate as acetone. Author (TAB)

N70-18958 Washington Univ., St. Louis, Mo.

COVALENT BONDING IN OCTAHEDRAL (MnCl6)(4–) AND TETRAHEDRAL (Mn-Cl4)(2–)

Fun Dow Tsay (Ph.D. Thesis) 1968 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-9014

The molecular orbital theory and the electron paramagnetic resonance method were employed to probe the covalent bonding in octahedral (MnCl6)(4−) and tetrahedral (MnCl4)(2−) complexes. The EPR spectrum of (MnCl6(4−) is found to exhibit extensive chlorine ligand hyperfine structure superimposed on some of the manganese nuclear hyperfine components. From the isotropic and anisotropic part of the spectrum, the covalency parameters which measure the fraction of electrons being transferred from ligand s−, and p-orbitals to central metal 3d-orbitals, were estimated. A comparison with the NMR results on KMnF3 indicates that covalent sigma-bonding for chlorine is much stronger than for fluorine. Dissert. Abstr.

N70-18972 Case Western Reserve Univ., Cleveland, Ohio.
THE SYNTHESIS AND DECOMPOSITION REACTIONS OF ORGANOGERMANIUM HYDROPEROXIDES AND PEROXIDES
George Carlton Farrant (Ph.D. Thesis) 1968 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-9398

Triorganogermyl hydroperoxides were prepared by a number of nucleophilic displacement reactions. The most convenient method of synthesis of the hydroperoxides consisted of reacting an appropriate organohalogermane with an excess of 98% hydrogen peroxide in ether, using anhydrous ammonia as the catalyst. After quenching the reaction mixture with water, the hydroperoxide could be recovered from the organic phase. The bis(triorganogermyl) peroxides were prepared by reaction of an appropriate organohalogermane with the correct amount of 98% hydrogen peroxide using ammonia as the catalyst. The reaction mixture was filtered, and the peroxide could be recovered from the filtrate. Both classes of compounds were well defined stable compounds which could be stored at room temperature for extended periods of time and almost indefinitely at −20 deg without any decomposition. Dissert. Abstr.

N70-18974 Pennsylvania State Univ., University Park.
THE DISSOLUTION OF LIME IN CALCIUM-IRON SILICA SLAGS AT 1375 C
William Joseph Schlitt, III (Ph.D. Thesis) 1968 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-9800

A study was made to determine some of the factors which affect the dissolution of lime in basic oxygen steelmaking slags. Hard and soft burned lime was allowed to partially dissolve in 14 calcium-iron silicate slags with FeO:SiO2 ratios ranging from 1.5 to 8.0 and CaO:SiO2 ratios increasing from 0.0 to 2.0. The slags were contained in Armco iron crucibles at 1375 C under an argon atmosphere. From the initial weight of the pellet and the amount of lime remaining after reaction with the slag, an apparent dissolution rate was calculated using the Dissolution occurred by diffusion of iron into the solid lime and penetration of a calcium iron oxide liquid phase into the pores. Presumably lime dissolved into the liquid and then diffused out into the slag. Silica did not penetrate into the lime, but did form an outer dicalcium silicate layer at low iron contents and basicities approaching one. Such a layer drastically reduced the dissolution rate. Dissert. Abstr.

N70-18975 Wisconsin Univ., Madison.
STUDIES IN COORDINATION NUMBER EIGHT, SOME ALPHA-HYDROXYCARBOXYLATES OF ZIRCONIUM(IV), HAFNIUM(IV) AND LANTHANUM(III)
Edwin Herman Homeier, Jr. (Ph.D. Thesis) 1968 197 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-935

Chemical and infrared evidence bearing on the structure of the tetrakis(d,1-mandelato)zirconium(IV) or hafnium (IV) complexes precipitated from aqueous solution is discussed. Absorption bands between 2500 and 1700 cm in the infrared spectra of the compounds are attributed to very short hydrogen bonds. In addition to these short O-H-O linkages, the compounds have some moderately strong hydrogen bonds with an oxygen-hydrogen stretch at about 2600 cm. To assist in the characterization of the tetramandelates, tetrakis(d,1-paraisopropylmandelato)zirconium(IV) and the corresponding tetra-lactate were synthesized. Although the lactate is much more easily hydrolyzed than those tetra-carboxylates in which the ligand possesses phenyl-rings, the data indicate that in the solid state all three of these intractable complexes have the same polymeric structure. Dissert. Abstr.

N70-18978 Case Western Reserve Univ., Cleveland, Ohio.
ARYNES BY ELECTRON IMPACT AND THERMAL FRAGMENTATION
Donald Frank Lindow (Ph.D. Thesis) 1968 60 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-9418

Electron impact and thermal fragmentation of biphenylene gives benzyne via a minor process; the major process is clevage of only one bond. The diradical produced by thermal clevage of one bond dimerizes in the liquid phase, leading to an essentially quantitative yield of tetraphenylene. The electron impact fragmentation pattern of biphenylene bears a striking resemblance to those of anthraquinone and fluorenone although the parent ion probably does not contain an intact four-membered ring. Based on isolated and characterized hydrocarbon products, it is concluded that the major reaction of benzyne with benzene gives benzobicyclo[2.2.2]octatriene by 1,4-addition (approximately 75%). Intermediate formation of benzocyclooctatetraene accounts for 15% of the hydrocarbon products while the remainder, biphenyl, is formed via another route which is not an insertion reaction of benzyne on benzene. Dissert. Abstr.

N70-18979 Case Western Reserve Univ., Cleveland, Ohio.
THE PRIMARY PROCESS IN PHOTOLYSIS OF ISOPROPYL NITRITE
Barbara Edsall Ludwig (Ph.D. Thesis) 1968 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-9422

The main dissociative primary process was studied in isopropyl nitrite vapor in the banded region of the spectrum, 3000 to 4000 A. Product quantum yields were measured at various temperatures, pressures, wave lengths, and pressures of added nitric oxide. The quantum yield data are represented. Computation of the primary quantum yield from the product quantum yields requires values of k sub 4/k sub 5. This ratio of rate constants was determined from a study of the pyrolysis of diisopropyl peroxide-nitric oxide mixtures. The primary yield values ranged from 0.36 at 26 deg to 0.47 at 125 deg, contrary to the usual assumption that primary yields are unity in alkyl nitrite photolysis. The primary dissociative yield is independent of wave length throughout the band system. Since a change in wave length corresponds to excitation of different vibrational levels of essentially the N−O stretch, it is concluded that this mode is not strongly coupled to the decomposition mode. A possible sequence of excited states is suggested which is compatible with the observed results. Dissert. Abstr.

N70-18980 Polytechnic Inst. of Brooklyn, N.Y.
THE FLUORESCENCE OF ACETONE IN FLASH PHOTOLYSIS AND ITS CORRELATIONS WITH THE PHOTOCHEMISTRY OF ACETONE
Joseph Edwin Knoll (Ph.D. Thesis) 1968 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 68-16252

In the present study, an apparatus was constructed and used to examine the long-lived fluorescence of acetone in the 3000 A intensity region of flash photolysis. The following results were obtained. At low incident flash intensities, the lifetime of the long lived fluorescing species was the same regardless of whether 2800, 3000, or 3100 A radiation was used. This lifetime was constant over the range of low incident intensities studied. At higher

incident flash intensities, this lifetime decreased as the incident intensity was increased. At 3000 A photolytic radiation, the decrease in the lifetime occurred in the same intensity region where the decrease in the C2H6/CO ratio of the flash photolysis products were observed. At 2800 A incident radiation, the change in lifetime with increasing intensity was greater than with 3000 A radiation, at the same absorbed intensity. Kinetic analyses of the fluorescence intensity vs. time data were made assuming mechanisms which included reactions between an excited triplet state of acetone and a free radical and between two excited triplets. Dissert. Abstr.

N70-18989 Texas A&M Univ., College Station.
DYNAMIC ANALYSIS AND OPTIMUM CONTROL OF DISTRIBUTED PARAMETER SYSTEMS WITH INTERACTION DUE TO CONVECTIVE FLOW WITH CHEMICAL REACTION
John Thomas Baldwin (Ph.D. Thesis) 1968 254 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 69-8462

The characteristics of the backflow cell model for flow systems of various holdup and mixing distributions were obtained. These include steady state and transient responses for reactor systems in which the resulting equations are nonlinear due to the reaction rate expression. The primary state variables are concentration, temperature, and coolant temperature which are dependent upon axial position. The maximum principle of Pontryagin is used in the optimization studies. The temperature profile to maximize the yield of an intermediate product of a chain reaction in a steady state reactor system with axial dispersion is obtained. The state variables for this type of system are described by a two-point boundary value system of differential equations in position. The adjoint variables resulting from the application of the maximum principle to this problem are also defined by a two-point boundary value system. Dissert. Abstr.

N70-18994 National Lending Library for Science and Technology, Boston Spa (England).
THE NATURE OF PARTICLE SIZE CHANGES ACCOMPANYING THE HYDROGEN REDUCTION OF TUNGSTEN OXIDES
I. S. Turgenev et al Oct. 1969 15 p refs Transl. into ENGLISH from Sbor., Mosk. Inst. Stali i Splavov (Moscow), no. 49, 1968 p 230–238
(NLL-RTS-5390) Avail: Natl. Lending Library, Boston Spa, Engl.: 22s 6d or 3 NLL photocopy coupons

The reduction kinetics of tungsten oxides and the particle size changes during reduction were analyzed by microthermal and color examination. The formation of fine tungsten powder from coarse-grained tunstic anhydride is explained experimentally, emphasizing the reduction of beta-oxide WO(2.90) to WO2. Microthermal phase reduction analysis of the beta-oxide using dry hydrogen heated to about 600 C produced powders which X-ray structural analysis indicated contained only alpha- and beta-tungsten. The formation of WO2 does not take place throughout the bulk of each beta-oxide crystal, but starts at isolated spots; the particles increase in size and number as reduction progresses, forming a conglomerate of fine WO2. Tungsten dioxide will only form in hydrogen with an adequate moisture content, and the use of moister hydrogen accelerates the reaction and produces coarser particles as does increasing the temperature. J.M.

N70-18998 New Mexico Univ., Albuquerque.
THE ELECTROLYTIC OXIDATION OF CARRIER-FREE IODIDE-131
Darryl Dean Jackson (Ph.D. Thesis) 1968 157 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-9251

Solutions of carrier-free iodate-131 were prepared by electrolytic oxidation of iodide-131 in 0.01 M sodium bicarbonate solution at a graphite anode. The rate of the oxidation, expressed in terms of the iodide fraction, was relatively independent of the total initial iodide concentration indicating that the reaction followed the first order rate law over the concentration range studied. Carrier-free iodate-131 solutions containing little extraneous material can be conveniently prepared in good yield using this method. No evidence for the formation of periodate could be found when carrier-free iodide-131 in sodium bicarbonate or sodium carbonate solution was electrolyzed at anode potentials of up to +1.90 volts vs. S.C.E. A potentiostat suitable for carrying out the controlled-potential electrolyses for this work was designed and constructed. Dissert. Abstr.

N70-18999# Catholic Univ. of America, Washington, D.C.
STOICHIOMETRY AND KINETICS OF THE CLEAVAGE OF SINGLY-BRIDGED BINUCLEAR CHROMIUM(III) COMPLEXES
Donald William Hoppenjans (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-9150

The stoichiometry and kinetics of the acid cleavage of a series of binuclear chromium(III) complexes have been determined. A tentative assignment of dimer configuration has been made, based on the absorption spectra of the dimers, on the configurations of their cleavage products and on the relative stability of these products. Isolation of dihalotetrammine fragments in one case and the general lack of halopentammine products in all cases is taken as an indication that the Cr-O bond to the tetrammine fragment is responsible for cleavage. The cleavage reactions were found to be high yield routes to many monomeric chromium ammines and the preferred route to the trans diacidotetraammine complexes. Dissert. Abstr.

N70-19002# Atomic Weapons Research Establishment, Aldermaston (England).
A COMPARISON OF THE NETWORK METHOD OF PULSE-HEIGHT ANALYSIS WITH CRYSTAL SPECTROMETRY FOR LIGHT ELEMENT MICROANALYSIS
G. V. T. Ranzetta and V. D. Scott Nov. 1969 18 p
(AWRE-O-51/69) Avail: HMSO 4s; BIS $0.80

Techniques to microanalyse the light elements such as boron, carbon, nitrogen, oxygen and fluorine are described. One method, pulse-height analysis, has been in use at AWRE for the past five years and, more recently, large d-spacing crystals such as KAP and stearates have become available. In the present report the two methods are compared with reference to qualitative and quantitative microanalysis. A few practical illustrations in metallurgy - inclusion identification and oxygen penetration into corroded metals - have been included for the qualitative evaluation. Quantitative aspects are discussed in terms of measurements on a series of carbides, chosen because of their good conducting property and the ready availability of a pure standard. The data indicate that the two methods do not always give identical results and it is suggested that the network method of pulse-height analysis has potential errors which arise from the basic assumption that the shape of the X-ray emission spectrum from a particular element differs only in intensity according to the amount of element present. Additional complications such as the overlapping of the light element spectrum with soft X-ray lines from the heavier elements are also discussed. Author

N70-19020# Kent State Univ., Ohio.
THE PYROLYSIS OF HYDROCARBONS USING A TRULY HOMOGENEOUS (WALL-LESS) REACTOR
David Alan Hutchings (Ph.D. Thesis) 1968 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-9558

A unique gas phase reactor has been developed in which the reaction is carried out under completely homogeneous (wall-less) conditions. In principle, the wall-less reactor as developed for this project, encompasses a flowing stream of hydrocarbon inside a protective cylinder of inert flowing gas. Neopentane pyrolysis has been extensively studied in the wall-less reactor. Under homogeneous conditions, the major products of the reaction are methane, ethane,

and isobutylene with ethylene, propylene, allene, 2-methyl-2-butene, 2-methyl-1-butene, isoprene, and trace amounts of a neohexane also being formed. The overall rate of decomposition of neopentane is first order, but the products are formed by more complex kinetics. Dissert. Abstr.

N70-19061 Texas A&M Univ., College Station.
ELECTRON PARAMAGNETIC RESONANCE STUDIES OF VALENCE TAUTOMER ANION RADICALS AND ION-PAIRING IN SEMIQUINONES
Robert Marion Owens (Ph.D. Thesis) 1968 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-8497

The epr spectral parameters of the monohomocyclooctatetraene anion radical (XXXV) have been found to be relatively insensitive to changes in solvent, temperature, and counterion. The similar geometry of the anion radical, XXXV, and the monohomocyclooctatetraene dianion (XXXVI) is noted. A disproportionation equilibrium between XXXVI, XXXV, and cis-fused bicyclo(6.1.0)nona-2,4,6-triene (XXXIV) is apparent. For the systems studied, the anion radical XXXV is favored over any of its valence tautomeric forms. The anion radicals formed during the alkali metal reduction of XXXIV in liquid ammonia were investigated. Potassium metal reduction of XXXIV in liquid ammonia produced solutions of the anion radical, XXXV. Similar results were obtained from the potassium reduction of cis-fused bicyclo(6.1.0)nona-2,4,6-triene-9,9'-d(2) (XLV) in liquid ammonia. In contrast, lithium or sodium reduction of XXXIV in liquid ammonia produced diamagnetic solutions which upon warming to +25 deg produced the methylcyclooctatetraene anion radical (XLI). Similar reductions of XLV in liquid ammonia produced solutions of the anion radical, R(2): those structure is not known. Dissert. Abstr.

N70-19065 Rensselaer Polytechnic Inst., Troy, N.Y.
THE SELECTIVE INHIBITION OF THE CATALYTIC HYDROGENATION OF ACETYLENE
John L. Cholette (Ph.D. Thesis) 1968 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8455

Conversions and selectivities were experimentally measured for palladium, platinum, and ruthenium catalysts supported on calcium carbonate, both in uninhibited state and after being modified by lead acetate and other metal salts. Activity decreased for inhibited palladium and platinum but increased for ruthenium. These results were shown to be caused by a decreased difference between the apparent activation energy for acetylene hydrogenation and that for ethylene hydrogenation in all cases where additives were used. The kinetic behavior of the reaction when the catalyst is modified by heavy metal additives is explained on the basis of an electronic interaction between catalyst metal and additive. An intrinsic reaction parameter was derived from a mathematical model of pulse reactor data. For inhibited catalysts only the selectivity factor changes; reaction order and thus reaction mechanisms are identical with unmodified systems. Dissert. Abstr.

N70-19068 National Lending Library for Science and Technology, Boston Spa (England).
A STUDY OF THE STRUCTURE AND SORPTION PROPERTIES OF CO-PRECIPITATED HYDROXIDES OF TITANIUM AND ALUMINUM AND THE DEPENDENCE OF THESE ON COMPOSITION AND THERMAL TREATMENT
N. F. Ermolenko et al Dec. 1969 13 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Khim. Navuk (Minsk)
(NLL-RTS-5501) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

Mixed samples of co-precipitated hydroxides of titanium and aluminum were prepared by adding an aqueous solution of ammonia to a mixture of A12(S04)3 and Ti02 in concentrated sulphuric acid. The mixture contained both components in fixed quantities. Samples of A1203-Ti02 containing up to 43 percent Ti02 basically show the adsorption properties of A1203; while samples containing from 60 to 91 per cent Ti02 strongly exhibit the adsorption properties of Ti02. The effect of mutual protection from crystallization was similar to that for other binary systems based on A1203. E.M.C.

N70-19076 California Univ., Riverside.
ELECTROCHEMICAL REDUCTION OF NITROAROMATIC COMPOUNDS IN LIQUID AMMONIATES. 2: ESR STUDIES OF PHOTOCHEMICALLY GENERATED RADICALS FROM NITROBENZENE AND CHLORONITROBENZENES
Roy Keith Darlington (Ph.D. Thesis) 1968 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-10094

The reduction of nitrobenzene and monosubstituted methyl-, chloro-, and fluoronitrobenzenes is studied at a bright platinum electrode in lithium nitrate ammoniate, LNA, and lithium perchlorate LPA. Cyclic and single sweep voltammetry, coulometry, and electron spin resonance, ESR, methods are used to determine the reduction mechanism. Photoinduced paramagnetism is observed for nitrobenzene and a number of chloro-substituted nitrobenzenes in tetrahydrofuran, THF, ethanol, and basic ethanol. During irradiation in THF and ethanol and ESR signal that is assigned to a short lived neutral nitrobenzene or chloronitrobenzene radical formed by hydrogen atom abstraction from the solvent is observed. In basic ethanol the stable nitro anion radical is formed during irradiation. When the light is turned off, the neutral nitro radical signal decays rapidly and a stable ESR signal is found. Dissert. Abstr.

N70-19077 California Univ., Riverside.
FLUORINE-19 NUCLEAR MAGNETIC RESONANCE STUDIES OF META AND PARA FLUOROPHENYL CARBORANES AND THEIR DERIVATIVES
Robert Garber Adler (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-10088

It was the purpose of this investigation to study the electronic properties of 1,2-dicarbaclovododecarborane (B10C2H12), and a number of its derivatives. Earlier work on the determination of the ionization constants for carboranyl benzoic acids and anilinium ions indicated that the carboranyl group has a strong inductive electron withdrawing effect on groups bonded at carbon. This effect was confirmed as a result of the determination of the inductive and resonance parameters. It was observed that the carborane groups became increasingly electron donating at carbon by both inductive and resonance mechanisms as the negative charge was increased. It thus appears that the negative charge on the pentagonal face of the carborane ion is partly relieved by sigma and pion addition to the attached aromatic ring. The 1,7 system appears to have greater electronic donating ability than the 1,2 system which is consistent with the trend observed in the neutral carboranes. Dissert. Abstr.

N70-19078 California Univ., Berkeley.
EXPERIMENTAL AND CALCULATIONAL STUDIES OF THE DYNAMICS OF A PACKED CATALYTIC REACTOR
Bjorn Christian Lyche (Ph.D. Thesis) 1968 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-10334

The dynamics of packed bed reactors is being studied to gain a better understanding of the physics of these systems. There are questions regarding such phenomena as diffusion within the catalyst particle, heat effects caused by ad- and desorption from the catalyst, how to treat the heat capacity of the wall, radial gradients, changes in molenumber during the reaction, effects of temperature and pressure on the linear velocity of the gas, and others. The objective of this study was to assess the importance of some of these phenomena by comparing experiments with computed results based on a mathematical model of the reactor. The reactor

considered here is one in which gases react with liberation of heat. The reaction occurs on a solid catalyst and is carried out in a nonisothermal fixed bed tubular reactor. It is known that for such a reactor one of the dominant dynamic effects is due to the heat capacity of the solid catalyst. The dynamic behavior of a packed bed reactor is therefore considerably different from the empty tube homogeneous reactor. Dissert. Abstr.

N70-19061 Cornell Univ., Ithaca, N.Y.
ELECTRON PARAMAGNETIC RESONANCE STUDIES OF HEISSENBERG SPIN EXCHANGE IN SOLUTIONS OF FREE RADICALS
Michael Paul Eastman (Ph.D. Thesis) 1968 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-7379

The effect of Heisenberg spin exchange or electron-electron spin exchange on the relaxation times of free radicals in solution was investigated using electron spin resonance spectroscopy. Linewidth studies show that exchange between radicals with the same nuclear spin configuration produces no observable linewidth effects. The theory developed by Freed for the effect of exchange on longitudinal relaxation times was verified using continuous saturation techniques. Electron-electron double resonance spectroscopy was applied to the study of exchange in aqueous solutions of peroxylamine disulfonate. It is shown that the reduction in observed signal intensity changes with the exchange frequency, as predicted by Freed's theory for the case of a single nucleus with a nuclear spin of 1. The second order rate constant for spin exchange between tetracyanoethylene anion radicals at 15 C in tetrahydrofuran and in dimethoxyethane is calculated.
Dissert. Abstr.

N70-19086# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Chemistry and Chemical Engineering.
EFFECTS OF SUBSTITUENT GROUPS ON C 13 NUCLEAR MAGNETIC RESONANCE Final Report, 27 Feb. 1963-15 Sep. 1969
Edmund R. Malinowski Nov. 1969 121 p refs
(Contract DA-31-124-ARO(D)-90)
(AD-697159; AROD-3930-15-C) Avail: CFSTI CSCL 7/4

Within recent years proton magnetic resonance has become a tool of prime importance for the elucidation of the structure of organic molecules. Since all organic compounds contain 1 per cent carbon-13 in natural abundance, the study of carbon-13 nuclear magnetic resonance (nmr) spectra should yield a wealth of information concerning the bonding and electron distribution within organic molecules. Several approaches to account for chemical shifts and spin-spin couplings were proposed for exploration. One method involved the systematic study of substituents effects. Since nmr measurements are made on compounds in liquid solvents, the factors which contribute to solvent effects must also be understood. The current investigation, then, is concerned with probing and hopefully elucidating the many factors involved in nuclear magnetic resonance phenomena, with particular emphasis on carbon-13. The material contained in the report is that which has not yet been published either due to incompleteness or newness.
Author (TAB)

N70-19087*# Techtran Corp., Glen Burnie, Md.
STUDIES OF THE PROPERTIES OF HYDROCYANIC ACID: POLAROGRAPHIC AND ULTRAVIOLET SPECTROSCOPIC ANALYSIS OF THE TETRAMER OF HYDROCYANIC ACID AND ITS RELATED COMPOUNDS
Kiyoshi Onoda Washington NASA Feb. 1970 12 p refs Transl. into ENGLISH from Nippon Nogeikagaku Kaishi (Tokyo), v. 36, no. 2, 1962 p 167-172
(Contract NASw-1695)
(NASA-TT-F-12822; Rept-3) Avail: CFSTI CSCL 07C

Polarographic and ultraviolet spectroscopic analyses were made of the tetramer of hydrocyanic acid and its related compounds. The empirical data most closely conformed to the structure, diaminomaleo dinitrile, which provided a structure suitable for use as a basis for the quantitative determination of (HCN)4. It was determined that (HCN)4 contains a >C=C< bond and the nitrile group. The detection of (HCN)4 in hydrocyanic acid by its fluorescence was found possible. Author

N70-19089 Cornell Univ., Ithaca, N.Y.
ELECTRO DIFFRACTION STUDIES OF THE STRUCTURES OF THIOPHENE, 2-CHLOROTHIOPHENE AND 2-BROMOTHIOPHENE
William Reid Harshbarger (Ph.D. Thesis) 1968 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-7284

The purpose was to ascertain the effect of halogenation on the aromatic thiophene ring. Two sets of diffraction patterns of thiophene were recorded, their ranges being 6 < or = to q < or = to 120 and 8 < or = to q < or = to 126. The molecular intensity functions for the two sets of data were independently fitted by least squares analysis. The diffraction pattern for 2-chlorothiophene was analyzed over the range of 3 < or = to q < or = to 115 and for 2-bromothiophene over the range of 4 < or = to q < or = to 119. Least squares analysis of the molecular intensity functions indicated that two significantly different structures fit the data comparably well for both the bromine and chlorine derivatives. Although these models are indistinguishable on the basis of their diffraction patterns, previous studies of the p.m.r. spectra and structure of thienyl-2-carboxylic acid are consistent with models in which the halogen atom withdraws sigma electron density from the thiophene ring but donates pion electron density to the ring. Both of the halogenated derivatives were determined to be planar. Dissert. Abstr.

N70-19090 National Lending Library for Science and Technology, Boston Spa (England).
ON THE POSSIBILITY OF THE FORMATION OF GASEOUS IONS IN A LIQUID WHICH IS SITUATED IN AN ELECTRIC FIELD
K. K. Stepanchuk Sep. 1969 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 11, Nov. 1967 p 35-38
(NLL-RTS-5303) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupon

Problems were examined on the mechanical and thermodynamic state of equilibrium at the gas-liquid boundary. Assuming a plane surface forming the boundary between the phases, mathematical expressions are developed for (1) the energy acquired by a molecule of gas on polarization in the gaseous medium and in a neutral liquid, (2) the chemical potentials for a pure gas and a gas dissolved in the liquid, (3) the chemical potential change in the presence of an electric field, and (4) the radius of the particle of gas under thermodynamic equilibrium and in a state of non-equilibrium created by the presence of an electric field. Mean squares of the electric field intensity are integrated for a graphical solution of the problem for nitrogen dissolved in benzole. The results indicate that the inception, stabilization, and growth of gas bubbles in transformer oil, are possible owing to over-saturation of the liquid on dissociation of the oil molecule in the presence of an electric field. This would be accompanied by the liberation of hydrogen, with the consequent development of electro-chemical voltaic reactions taking place at the gas-liquid boundary. D.L.G.

N70-19096 Wisconsin Univ., Madison.
HIGH PRESSURE VAPOR-LIQUID EQUILIBRIA
Aage Fredenslund (Ph.D. Thesis) 1968 199 p
Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 69-910

The study of high pressure vapor-liquid equilibria is divided into three parts: (1) gas-liquid equilibrium of the oxygen-carbon dioxide system; (2) thermodynamic analysis of the oxygen-carbon dioxide equilibrium data, and (3) a molecular theory of solutions. An

experimental facility for the study of high pressure vapor-liquid equilibria is constructed. The equilibrium phase compositons are determined for the O2 - CO2 system at the -50, -40, -30, -20, -10, 0, and +10 C isotherms and pressures from 130 atm. down to the saturation pressure of CO2, in 10 atm. increments. Both isothermal and isobaric phase diagrams are constructed. The thermodynamic analysis is based on an unsymmetric convention for the normalization of the activity coefficients. Dissert. Abstr.

N70-19097 California Univ., Riverside.
THE ELECTROCHEMICAL REDUCTION OF SUPEROXIDE ION AND OXIDATION OF HYDROXIDE ION IN DIMETHYLSULFOXIDE, PART 1. THE ELECTROCHEMICAL OXIDATION OF HYDROXYLAMINE AT PLATINUM AND GOLD ELECTRODES IN DIMETHYLSULFOXIDE, PART 2. ELECTROCHEMISTRY OF GOLD(I) AND ITS COMPLEXES IN ACETONITRILE, PART 3
Alvin Dale Goolsby (Ph.D.Thesis) 1968 153 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-10099

Superoxide ion is reduced electrochemically on mercury or gold in dimethylsulfoxide containing tetraethylammonium perchlorate as the supporting electrolyte by a one-electron diffusion controlled process. Hydroxide ion is oxidized electrochemically by a diffusion controlled irreversible one-electron process on platinum or gold in dimethylsulfoxide containing tetraethylammonium perchlorate as the supporting electrolyte. Hydroxylamine hydrochloride and hydrosulfate are oxidized electrochemically by a diffusion controlled irreversible two-electron process on platinum in dimethylsulfoxide with carefully controlled solvent neutrality. Gold metal is oxidized electrochemically by a diffusion-controlled reversible one-electron process in acetonitrile containing tetraethylammonium perchlorate as the supporting electrolyte. Dissert. Abstr.

N70-19107# National Bureau of Standards, Washington, D.C. Analytical Chemistry Div.
MICROCHEMICAL ANALYSIS SECTION: SUMMARY OF ACTIVITIES, JULY 1967 TO JUNE 1968
John K. Taylor, ed. Oct. 1968 145 p refs
(NBS-TN-455) Avail: SOD $1.25

General activities are reported in the areas of gas analysis, polarography, potentiometry, coulometry, chemical microscopy, and classical microchemical analysis. Research activities described in some detail include: determination of trace amounts of oxygen in gases, development of a coulometric method for precise analysis of boric acid, improvements in microdetermination of silver and fluorine by null-point potentiometry, the electrochemical generation of fluoride ion, preparation of resin-bead particle standards, and determination of trace elements by the nuclear track technique. A number of microchemical procedures which have been developed for the analysis of a variety of materials are also included. Author

N70-19108 National Lending Library for Science and Technology, Boston Spa (England).
COLORIMETRIC DETERMINATION OF CYCLOHEXANONE IN THE PRESENCE OF ACETONE IN AIR
J. Adamiak Oct. 1969 12 p refs Transl. into ENGLISH from Chem. Anal. (Warsaw), v. 13, no. 4, 1968 p 895-900
(NLL-RTS-5380) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

A method based on the coupling of cyclohexanone with diazonium salt of H acid is described, and parameters affecting the absorption of cyclohexanone are discussed. The volume of air passed through in relation to the amount of water was varied, and both sampling methods and analyzing the whole volume were used. The effects of coupling time of cyclohexanone with H acid, the amount of H acid, and the concentrations of sodium sulphite and potassium hydroxide on the absorption of 0.05 mg cyclohexanone were determined. The possibility of obtaining 95% capacity of cyclohexanone absorption was shown, taking 4 ml of absorbing solution in an air sample not exceeding 2.6 liters. The limit of determination in one liter of air was determined to be 0.005 mg/1, and the relative standard deviation did not exceed 0.1. N.E.N.

N70-19110# Army Electronics Command, Fort Monmouth, N.J. Electronic Components Lab.
LINEAR SWEEP VOLTAMMETRY IN LITHIUM CHLORIDE-POTASSIUM CHLORIDE EUTECTIC AT 450 C
Wishvender K. Behl Sep. 1969 28 p refs
(AD-696430; ECOM-3178) Avail: CFSTI CSCL 7/4

Linear sweep voltammetry of Ag(I), Pt(II), Ni(II), and Co(II) was studied at platinum wire and glassy carbon electrodes in molten lithium chloride-potassium chloride eutectic at 450C. The diffusion coefficients of Ag(I), Pt(II), Ni(II), and Co(II) were determined from the linear peak current versus square root voltage plots. Author (TAB)

N70-19118 North Carolina Univ., Chapel Hill.
FUNDAMENTAL STUDIES OF LIGHT EMISSION AND ADSORPTION FROM PHOTOLYTICALLY AND ELECTROLYTICALLY PRODUCED EXCITED STATES, PART 1. OPTICALLY TRANSPARENT THIN-FILM THIN-LAYER ELECTROCHEMICAL CELL AND THIN-LAYER ELECTROCHEMICAL STUDIES OF AROMATIC HYDROCARBONS, PART 2
Attila Yildiz (Ph.D. Thesis) 1968 120 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-10219

An unusual delayed emission was observed for solutions of 5,6,11,12-tetraphenyltetracene (rubrene) in flash photolysis studies of this compound. The first triplet state of rubrene can be populated by sensitization with biacetyl or benzophenone. This new emission is interpreted as triplet yields triplet fluorescence within the triplet manifold of rubrene. Various data in support of this emission mechanism are presented. Electrodes based on deposited-metal thin films are described and evaluated for thin-layer electrochemistry. The application of such electrodes for controlled-potential and controlled-current techniques is demonstrated for several model systems. Ultraviolet and visible transmission experiments and a unique fluorescence application are described. Minimum edge-effect spectroscopic utility, ease and rapidity of construction, and minimal cost are seen as the principal advantages over previous designs. Dissert. Abstr.

N70-19129 California Univ., Berkeley.
INTRAMOLECULAR POTENTIAL FUNCTIONS FROM VIBRATIONAL ANALYSIS AND AB INITIO CALCULATION
Paul Norton Noble (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-10361

Photolysis of mixtures of F2 and O2 at 20 K produces infrared absorptions from O2F radical whose bandwidths are substantially narrower than in previous studies. Photolysis of mixtures of F2 and H2O suspended in a nitrogen matrix at 20 K produces several new infrared absorptions. Growth and diffusion studies, isotopic labeling, and normal coordinate analysis helps to assign bands at 3483.1, 1393.0, and 884.0/cm to HOF. A band at 3777/cm is attributed to HF hydrogen-bonded in the same matrix cage to HOF. A brief discussion of the formalism and history of ab initio calculations, especially as regards HF2(−) ion, is presented. Correlation error in SCF calculations is defined, and attempts to estimate its magnitude in calculations of chemical interest are reviewed. Dissert. Abstr.

N70-19136 Duke Univ., Durham, N.C.
CYCLIC ORGANOSILANEDIAMINO AND HEXAFLUOROPROPANE-2,2-DIAMINO DERIVATIVES OF DIBORANE (4)
Roger Wayne Nelson (Ph.D.Thesis) 1968 210 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-9070

The compounds were synthesized by metalation-coupling, dehydrohalogenation and/or transamination reactions; the products represent the first examples of several new ring systems incorporating a boron-boron bond. Chemical and physical evidence for the structures of these cyclic diborane(4) derivatives are given, and mechanisms are proposed to account for the anomalous courses of some of the reactions. Spectral data obtained with all the products are presented and discussed; except for the very high frequency in the infrared spectra of the hexafluoropropane-2,2-diamino derivatives, all the spectra are normal for diboron compounds. It is possible to draw the tentative conclusion that the CN2B2 rings in some of the products do not resemble the iso-electronic five-carbon ring of cyclopentadiene. Dissert. Abstr.

N70-19137*# Techtran Corp., Glen Burnie, Md.
DIFFUSION OF GASES THROUGH METALS [RECHERCHES SUR LA DIFFUSION DES GAZ A TRAVERS LES METAUX]
V. Lombard Washington NASA Jan. 1970 12 p refs Transl. into ENGLISH from Rev. Met. (Paris), v. 26, no. 7, Jul. 1929 p 343-350
(Contract NASw-1695)
(NASA-TT-F-12806) Avail: CFSTI CSCL 07D

The diffusion of hydrogen through metals, under various temperatures and pressures, chiefly with nickel, was investigated. Other elements involved to some extent are iron, platinum, nitrogen, argon and helium. It was found that when hydrogen is mixed with other gases there is no difference in the rate of diffusion. The tests concerning nitrogen, argon and helium do not provide any definitive results because of poor apparatus. It was found in addition that metal sheets placed close to one another have an additive value as far as hydrogen diffusion is concerned, i.e., hydrogen diffuses through 2 mm of nickel just as rapidly whether the nickel is a solid piece or two pieces in close conjunction. Author

N70-19138*# Techtran Corp., Glen Burnie, Md.
STUDIES OF THE PROPERTIES OF HYDROCYANIC ACID: ON THE DERIVATIVES OF THE HYDROCYANIC ACID TETRAMER
Kiyoshi Onoda Washington NASA Feb. 1970 11 p refs Transl. into ENGLISH form Nippon Nogeikagaku Kaishi (Tokyo), v. 36, no. 3, 1962 p 255-259
(Contract NASw-1695)
(NASA-TT-F-12824; Rept-4) Avail: CFSTI CSCL 07C

Condensation compounds of the hydrocyanic acid tetramer, (HCN)4, were formed and analyzed by ultraviolet absorption spectroscopy, confirming that (HCN)4 is dicyanomaleo dinitrile. The amino group in (HCN)4 was found to be in the cis position. It was concluded from a decrease in ultraviolet absorption when (HCN)4 reacts with acetic anhydride and hydrogen chloride, that a portion of the diaminomaleo dinitrile isomerizes to aminoimino succino nitrile. Author

N70-19145# Oak Ridge National Lab., Tenn.
DISSOCIATION PRESSURE OF BISMUTH IN THE SYSTEM: BISMUTH-THORIUM
Olaf Dahlke et al [1969] 8 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 60, 1969 p 465-468 Sponsored by AEC
(ORNL-TR-2218) Avail: CFSTI

The dissociation pressure of bismuth in the system bismuth-thorium was determined between 600 and 1400 C using the Knudsen effusion method. Isothermal dissociation curves and X-ray diagrams corroborated the compounds ThBi2 and Th3Bi4 which do not form solid solutions. For ThBi a narrow range of homogeneity between ThBi1.08 and ThBi0.8 is indicated. The supposed compound Th2Bi was not found using measurements of the partial pressure. Log values are included for the vapor pressure and for the pressure of dissociation of bismuth in the univariant equilibria. Author (NSA)

N70-19160 Cornell Univ., Ithaca, N.Y.
TRAPPING OF PARTICLES IN COMPACTING, MOVING BEDS OF SOLIDS
Newton Charles Merriman Landis (Ph.D. Thesis) 1968 221 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-8852

The trapping of particles in compacting, moving beds of solids as a technique for filtration or clarification is evaluated. It was desired to determine the physical characteristics of moving beds as opposed to static beds and factors which affect filtration or clarification in moving beds. Of the filter media used in the experiments, sand was the most effective in removing particles in the one micron size range. No difference was noted in the filtration properties of a moving sand bed compared with a static sand bed. Beds of the polyethylene filter media which were moved more rapidly than about 1 foot/hour in the conically shaped column tended to become unstable. Anthracite and activated carbon were not effective in clarifying the wheat starch and corn starch suspensions. Dissert. Abstr.

N70-19166 Catholic Univ. of America, Washington, D.C.
DEVELOPMENT OF A NEW TECHNIQUE FOR MONOLAYER ANALYSIS AND ITS USE IN AN INVESTIGATION OF THE HYDROLYSIS OF TRIPALMITIN
James Edward Charbonneau (Ph.D. Thesis) 1968 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-9114

A technique was developed to analyze monolayers on liquid substrates and was tested in an investigation of the hydrolysis of tripalmitin. A radioactively tagged monolayer was spread on the surface of a solution in a Langmuir tray and compressed to a constant pressure as measured by a modified Wilhelmy plate balance. Samples were taken from the monolayer at regular intervals using a platinum loop. Each sample was analyzed by chromatography on glass fiber paper and counted for radioactivity using a scalar and detector. The hydrolysis of tripalmitin was studied on a substrate of NaOH-NaCl of different base and salt concentrations. The reaction scheme for tripalmitin was verified to be tripalmitin yields dipalmitin yields monopalmitin yields palmitic acid.
Dissert. Abstr.

N70-19167 Nebraska Univ., Lincoln.
THERMOCHEMICAL STUDIES IN THE HIGH DIELECTRIC CONSTANT SOLVENT N-METHYLPROPIONAMIDE
Jerry Lee Curnutt (Ph.D. Thesis) 1968 145 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-9618

NMP (N-methylpropionamide) was investigated as a potential solvent for electrolytes. Integral heats of solution at 25 C for LiCl, LiBr, NaBr, KBr, NaI, KI, CsI, NaCl, and KF in anhydrous NMP are reported. Using available hat of solution data in the literature, along with lattice energies for the alkali metal halides, the enthalpies of solvation of the alkali metal halides in the substituted amide series, dimethylformamide, formamide, N-methylformamide, N-methylacetamide, and N-methylpropionamide were evaluated. The variations in the thermal properties of the alkali metal halides in these amide solvents are discussed in relation to the degree of association present in the pure anhydrous amide. The enthalpies of solvation for the alkali metal halides are, in general, more exothermal in the amide solvent than in water. Within the amide series, they are, in most cases, more exothermal in dimethylformamide, which is not associated through hydrogen bonding, and less exothermal in NMP, where association appears to reach a maximum.
Dissert. Abstr.

N70-19170# Scientific Translation Service, Ann Arbor, Mich.
POSSIBILITY OF XENON COMPOUNDS SYNTHESIS UNDER NATURAL CONDITIONS [K VOPROSU O VOZMOZHNOSTI SINTEZA SOEDINENII KSENONA V PRIRODNYKH USPOVIYAKH]
Yu. K. Gucev et al Nov. 1969 9 p refs Transl. into ENGLISH from Geokhimiya (Moscow), No. 7, 1969 p 835-839 Sponsored

by Argonne Natl. Lab.
(ANL-Trans-783) Avail: CFSTI

The possibility of xenon compound formation under natural conditions was considered. Mass spectrometric methods of searching for xenon compounds in minerals containing U, Th, Te, I and soluble in nitric, sulfuric and hydrofluoric acids are proposed. The method is based on the use of differences in physicochemical properties of xenon and its compounds. The possibility of using the proposed methods was verified on preparations of iodine pentoxide irradiated by neutrons. It is shown that 1 to 3 per cent of the total amount of Xe-128 that is formed during irradiation of iodine pentoxide by neutrons proves to be in a chemically bound state. Author (NSA)

N70-19178*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SPECTRAL EMITTANCE OF SOOT
Curt H. Liebert and Robert R. Hibbard Washington Feb. 1970 12 p refs
(NASA-TN-D-5647; E-5435) Avail: CFSTI CSCL 07D

The spectral emittances of thin layers of soot were experimentally determined over the wavelength range of 0.35 to 14 millimicron and at the two temperatures of 300 and 670 K. The soot was deposited from a smoky flame on transparent and reflective substrates, and soot layer thicknesses and emittances were measured on these substrates. The experimental results are compared with the predictions of simplified classical radiation absorption theory and with Hottel's widely used empirical relation. The results indicate that good assessments of the emittances of soot over broad ranges of temperature, thickness, and wavelength can be obtained by use of either the classical theory or the empirical theory. Author

N70-19191 National Lending Library for Science and Technology, Boston Spa (England).
PHYSICAL CHEMICAL THEORETICAL PRINCIPLES OF SURFACE FORMATION IN ELECTROCHEMICAL MACHINING
L. M. Scherbakov Dec. 1969 8 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabot. Mat. (USSR), no. 5, 1968 p 36-39
(NLL-RTS-5217) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupons

Equations describing the process of surface formation during dimensional electrochemical processing are obtained. Mass transfer, charge, and other macroscopic effects occurring on the surface of the metal, in the boundary layer, and in the outside stream of the electrolyte are cited to explain the process of anode solution of metal during electrochemical machining. The effect of polarization of the anode is taken into account in the macroscopic analysis through the hydrodynamic coefficient of yield. The analysis is based on the supposition that surface formation during electrochemical machining consists in determining the form and position of the surface being processed at any moment of time, thus the chief kinematic-geometric characteristics of the process will be the local linear velocity of metal removal, examined as a function of time and the coordinates of the point of the surface being processed. It is concluded that the main difficulty in solving the formulated problem consists in establishing the relationship between the yield coefficient and the hydrodynamic cycle of the electrolyte flow. E.M.C.

N70-19193 Case Western Reserve Univ., Cleveland.
TRANSPORT IN ASYMMETRIC POLYMER MEMBRANES
Shmuel Sternberg (Ph.D. Thesis) 1968 127 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9450

A general mathematical model was developed, which attributes the overall directional permeation rate effect to a gradient of solubility properties across the thickness of the membrane. The validity of the model was confirmed for the permeation of methanol through a well characterized polyethylene membrane possessing a linear gradient of grafted poly(vinyl acetate). The model can be used to predict the mass transport properties of membranes. The preference factor, defined as the ratio of flux along and against the gradient of solubility properties can be calculated. The solubility properties of the pure components were represented by a mathematical expression derived from the Flory – Huggins theory. A preliminary investigation was made of corresponding electrochemical effects expected when electrolyte solutions are used with a membrane possessing a gradient of ion-exchange capacity. It was shown that the graded membrane can give rise to a finite, constant voltage differential even in the absence of an external activity differential. Also, the slope of the potential versus activity curve was shown to be affected by the surface properties of the membrane. Dissert. Abstr.

N70-19204# Mississippi Univ., University. Dept. of Chemistry.
INVESTIGATION OF GAMMA-RAY INDUCED POLYMER FORMATION OF THE CARBORANES Annual Progress Report
Theodore J. Klingen 1 Dec. 1969 44 p refs
(Contract AT(40-1)-3781)
(ORO-3781-6) Avail: CFSTI

The gamma-induced polymer formation in 1,2-dicarbacloso-dodecaborane (o-carborane) and its c-alkyl derivatives was investigated. Irradiation of 1-vinyl-O-carborane was carried out on degassed samples. Monomers, dimers, trimers, tetramers, and possibly higher polymeric units were formed. The polymeric mixture was found to be stable to air and water at room temperature. Heating it for extended periods of time above 300 C in air produced no detectable changes in its composition or structure. NSA

N70-19214# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
CALCULATED CRITICAL RADII FOR BARE SPHERES OF URANYL NITRATE-NITRIC ACID SOLUTIONS AND URANIUM-WATER MIXTURES
D. W. Magnuson 15 Mar. 1969 6 p
(Contract W-7405-eng-26)
(Y-DR-11) Avail: CFSTI

Criticality calculations were performed to show the effects of changes in the isotopic content and changes in nitric acid content on the critical sphere radii for various uranium concentrations. The atomic densities for the solution components, calculated bare critical radii, and changes in critical radii are presented. NSA

N70-19216 Wisconsin Univ., Madison.
VISCOELASTIC PROPERTIES OF 1,2, AND CIS-1,4 POLYBUTADIENES AND BUTYL RUBBER
James Frederick Sanders (Ph.D. Thesis) 1968 262 p
Avail: Univ. Microfilms: HC $11.95/Microfilm $3.40 Order No. 68-17936

The linear viscoelastic properties of a series of four cis-poly(butadiene) (cis-PB) vulcanizates, a series of seven butyl rubber (BR) vulcanizates, and one unvulcanized 1,2-poly-(butadiene) (1,2 PB) sample were measured. The cis-PB was vulcanized with dicumyl peroxide, while the BR was vulcanized with sulfur. The mechanical properties of the least vulcanized of the cis-PB series were measured before and after extraction of the sol fraction with benzene. Time-temperature reduction was used to extend the measurements over all or part of the frequency range. The locations of the secondary dispersions for the least vulcanized samples were compared. The value of the storage compliance plateau was obtained from graphical integration of the loss compliance. The equilibrium compliance was calculated for the vulcanizates by an extrapolation procedure. Dissert. Abstr.

N70-19223*# Techtran Corp., Glen Burnie, Md.
THE SUB-OXIDES OF CESIUM [SUR LES SOUS-OXYDES DE CAESIUM]
E. Rengade Washington NASA Jan. 1970 4 p refs Transl. into ENGLISH from Compt. Rend. (Paris), v. 148, May 1909

p 1199-1202
(Contract NASw-1695)
(NASA-TT-F-12808) Avail: CFSTI CSCL 07D

The properties of cesium suboxides were recorded. Four of them were found by operating in a nitrogen atmosphere under a vacuum. The main point is the finding that cesium suboxides, although derivatives of alkaline metals, are not necessarily monovalent. Author

N70-19224 Wisconsin Univ., Madison.
STEREOCHEMICAL INVESTIGATIONS OF TRANSITION METAL COMPLEXES BY NUCLEAR MAGNETIC RESONANCE
Richard Edward Ernst (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 68-17889

The isotropic hyperfine contact shifts in the nuclear magnetic resonance spectra of four series of tris(chelate)-vanadium(III) complexes were measured in order to determine structures in solution and to define qualitatively the mode of unpaired spin delocalization predominantly responsible for these shifts. The four types of compounds investigated were beta-diketonates, beta-ketoamines, salicylaldehydes, and salicyl-aldimines. From comparison of the signs and magnitudes of the observed contact shifts with calculated spin density distributions for the ligands, it was concluded that metal-to-ligand parallel spin transfer is the principal mode of spin delocalization. The ML2 complexes, in which L is a bidentate ligand possessing an asymmetric center, can exist in two diastereoisomeric forms. The investigation was extended to complexes with four asymmetric centers present as two inequivalent pairs. It is demonstrated that six pmr-distinguishable diastereoisomers are possible for these complexes, and signals corresponding to the six isomers were observed in the pmr spectra. The results of deuterium labeling and exchange experiments, which were followed by proton resonance, have revealed that loss of optical activity proceeds by racemization at the alpha-carbon of the N-alkoxycarbonyl group. Dissert. Abstr.

N70-19238 Rensselaer Polytechnic Inst., Troy, N.Y.
ELECTRONIC ABSORPTION SPECTRA OF Co II, Cr III, AND Re IV IN SOLUTIONS AND MELTS
Mahmoud Ismail El-Guindy (Ph.D. Thesis) 1968 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-13508

The important factors affecting the octahedral-tetrahedral equilibrium of Co II ions in chloride and bromide hydrate melts and in aqueous halide solutions were studied spectroscopically. The heat of reaction for the previous equilibrium was determined in different media and found to depend upon the melt cation. Values of Delta H between 35 C. and 75 C. were found to be 11.1 Kcal./mole in aqueous MgCl2 solutions, 10.5 Kcal./mole in aqueous MgCl2+LiCl solutions, 14.95 in aqueous CaBr2 solutions and 10.5 Kcal./mole in aqueous CaBr2+KBr solutions. Dissert. Abstr.

N70-19244# Los Alamos Scientific Lab., N.Mex.
THE SOLUBILITIES OF SELECTED ELEMENTS IN LIQUID PLUTONIUM. PART 15: LANTHANUM
K. C. Brooks and D. F. Bowersox 25 Aug. 1969 4 p refs
(Contract W-7405-eng-36)
(LA-4282) Avail: CFSTI

The solubility of lanthanum in liquid plutonium was measured over the range of 700 to 825 C. The solubility, which was measured in CaF2 crucibles, increased from 0.31 wt % lanthanum at 700 C to 0.95 wt % at 825 C. The temperature range was limited because of the appearance of two immiscible liquids at 850 C. The equation log N sub La = 1.923 - 4.086 x 1,000 T/1, where N sub La is the solubility expressed as the mole fraction and T is the temperature in degrees Kelvin, fits the data in the temperature range studied. Author (NSA)

N70-19249 California Univ., Riverside.
GAS-SOLID CHROMATOGRAPHY USING SALT-MODIFIED ALUMINAS AND POROUS SILICA BEADS
David Joseph Brookman (Ph.D. Thesis) 1968 117 p
Avail: Univ. Microfilms: HC $5.80/ Microfilm $3.00 Order No. 69-10090

Exploratory studies have been made on the use of salt-modified adsorbents as the stationary phase for gas-chromatographic separations of organic compounds. The quantitative isolation of factors causing retention differences between various compounds is of particular utility. (1) Specific interactions affect retention for modified alumina columns; (2) Correlation of aromatic substituent effects with retention; (3) A thermodynamically based gas chromatographic retention index for organic compounds using salt-modified adsorbents; (4) Chromatographic studies of cyclic hydrocarbons on salt-modified adsorbents. Dissert. Abstr.

N70-19250 Wisconsin Univ., Madison.
CHEMICAL AND STRUCTURAL STUDIES OF SOME ORGANO-COBALT AND NICKEL COMPLEXES
Vernon Albert Uchtman (Ph.D. Thesis) 1968 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 68-17945

The synthesis of three organometallic complexes, (C5H5)4-CO4S6, (C5H5)3CO3(CO)(O), and (C5H5) 3NI2CO(CO)2, have been carried out. The crystal and molecular structures of these complexes, as well as those of duroguinone-cyclopentadienyl-cobalt dihydrate, have been determined from three-dimensional single-crystal x-ray structural analyses. An investigation of the reaction of elemental sulfur with C5H5Co(CO)2 resulted in the synthesis and characterization of a new organometallic sulfur complex, (C5H5)4CO4S6. The synthesis and structural analysis of the diamagnetic mixed-metal complex (C5H5)3NI2Co(CO)2, prepared from the reaction of (C5H5NICO)2 with C5H5Co(CO)2, were carried out. From an effort to obtain a sample of the known complex (C5H5CoCO)3, a new complex (C5H5)3CO3(CO)(O) was obtained in very low yield from the prolonged U.V. irradiation of a C5H5CO(CO)2 solution. Dissert. Abstr.

N70-19263 Stanford Univ., Calif.
THE ROLE OF DENDRITES IN SPHERULITIC CRYSTALLIZATION
George Trask Geering (Ph.D. Thesis) 1968 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-8183

Glycerol-water solutions with 2 to 8 mols/liter concentration were frozen in an alcohol bath over a range of temperatures. Ice spherulites composed of radiating filaments (or dendrites) were observed and their growth rates and spacings measured. A computer model for filament growth was developed and used to calculate growth rates. The calculated values for a single filament were in good agreement with the measured values for spherulites of large interfilament spacing. The interfilament spacing of some of the spherulites was measured from motion picture frames and found to vary inversely with the growth rate, in agreement with a simple calculation of the transport controlled growth of a filament array. X-ray diffraction at 77 K was used to establish that hexagonal ice, faulted hexagonal ice, cubic ice, and amorphous ice was present in glycerol-water solutions frozen at successively lower temperatures. Dissert. Abstr.

N70-19276# Atomic Power Development Associates, Inc., Detroit, Mich.
EVALUATION OF MATERIALS WASTAGE DUE TO REACTIONS OF WATER IN SODIUM
H. V. Chamberlain, A. J. Kanamori, and P. S. Lindsey Jun. 1969 39 p refs
(Contract AT(11-1)-865)
(APDA-227) Avail: CFSTI

A review has been made of the literature pertaining to reactions of water with Na, with particular emphasis on the factors

influencing wastage of materials in such reactions. The main objective of the review was to determine if sufficient experimental data exist to develop a correlation of the various factors which affect materials wastage rates. Descriptions are given of the various test rigs used in the experimental investigations, and the various factors affecting material wastage rates are discussed. Recommendations are given for the future development of additional data in the reported area of interest. Author (NSA)

N70-19280 Oklahoma Univ., Norman.
DIMERIZATION AND HYDRATION OF BENZOIC ACID AND SALICYLIC ACID IN APROTIC SOLVENTS
Roger Lynn Van Duyne (Ph.D. Thesis) 1969 139 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-8602

Distribution and solubility data were collected at 25°C for the systems: benzoic acid-benzene, salicylic acid-carbon tetrachloride, salicylic acid-benzene, and salicylic acid-ethylene dichloride. These data were interpreted in terms of molecular association equilibria involving acid and dissolved water. Acid dimerization is the most significant association process taking place in each system, but hydration processes are also important. Monomer monohydrate, monomer dihydrate, and dimer monohydrate species must be considered together with anhydrous acid monomer and anhydrous acid dimer species in order to explain satisfactorily all the data. Reasonable values of the association constants, monomer distribution constant, and standard errors in each constant were inferred from nonlinear least squares analysis of the data for each system. Dissert. Abstr.

N70-19283 California Univ., Berkeley.
EQUATION OF STATE OF He-4 NEAR THE CRITICAL POINT
Pedro Leonardo Mascheroni (Ph.D. Thesis) 1969 142 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-10346

The calculation of the equation of state of He-4 near the critical point is made using the theory developed by Riesenfeld and Watson. It is then found that by using a pseudopotential it is possible to solve the selfconsistent equations in the effective mass approximation and in the first approximation of the nearest neighbor expansion. The computations show that the Van der Waals equation is an approximated solution of the problem with good semiquantitative results for the critical point. Author

N70-19289*# Techtran Corp., Glen Burnie, Md.
KINETICS AND MECHANISM OF THE THERMAL DECOMPOSITION OF SILVER SULFITE
M. V. Gilevich et al Washington NASA Jan. 1960 11 p refs Transl. into ENGLISH from Geterogennye Khim. Reakt. (Minsk), 1961 p 31-41
(Contract NASw-1695)
(NASA-TT-F-12539) Avail: CFSTI CSCL 07B

Thermal decomposition of silver sulfite is studied between 160 and 180 C. The reaction rate varies directly with temperature. Self-acceleration is noted. The reaction products are metallic silver, silver sulfate, and sulfur dioxide. The addition of powdered metals, salts, gaseous hydrogen and other reducing impurities accelerate the reaction. Materials hindering participation of free radicals slow down the reaction. The reaction of thermal decomposition of silver sulfite is structure-sensitive. Author

N70-19295 Maryland Univ., College Park.
CONDENSATION HEAT TRANSFER FOR VAPORS OF IMMISCIBLE LIQUIDS OUTSIDE HORIZONTAL COPPER TUBES
James Aubrey Sykes, Jr. (Ph.D. Thesis) 1968 149 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-9584

Film heat transfer coefficients for the condensation of pure water, toluene, and carbon tetrachloride and the corresponding-water-organic eutectics were obtained experimentally and compared with data where available. A laminar flow model for the condensation of eutectics was analyzed and two correlations were proposed. The model and correlations were compared with all data available for the condensation of eutectics on horizontal tubes. A model based on a nucleation resistance at the vapor-liquid interface is proposed. Utilizing Langmuir's analysis for an immiscible lens on an infinite horizontal liquid surface, a simple correlation parameter is defined. A two film laminar flow model for eutectic condensation was found to predict neither a bound nor the correct temperature dependence for the eutectic heat transfer coefficients. Dissert. Abstr.

N70-19320*# Techtran Corp., Glen Burnie, Md.
STUDIES OF THE PROPERTIES OF HYDROCYANIC ACID ON THE MOLECULAR STRUCTURE OF THE TETRAMER OF HYDROCYANIC ACID
Kiyoshi Onoda Washington NASA Feb. 1970 11 p refs Transl. into ENGLISH from Nippon Nogei Kagaku Kaishi (Japanese), v. 36, no. 4, 1962 p 370–374
(Contract NASw-1695)
(NASA-TT-F-12823; Rept-6) Avail: CFSTI CSCL 07C

It was determined from infrared absorption that the tetramer of hydrocyanic acid has a alpha, beta amino bond in its unsaturated bond, and that, since this is an enamine, the principal component of the (HCN)4 crystal has a diaminomaleo dinitrile (I) structure but that the aminoimino succino dinitril (II) structure is also present, although in small quantities. It was newly discovered that the tautomer (I) is converted to (II) in a strongly acidic state and conclusions concerning this conversion were drawn from polarographic test results. Author

N70-19341# Oak Ridge National Lab., Tenn.
THE SOLUBILITY OF Fe_3O_4 IN DILUTE ACID AND BASE SOLUTIONS TO 300 DEG C
F. H. Sweeton, C. F. Baes, Jr., and G. H. Jenks 31 Jul. 1969 19 p refs Presented at the 15th Ann. Meeting of the Am. Nucl. Soc., Seattle, Wash.
(ORNL-TM-2667; CONF-690609-24) Avail: CFSTI

The solubility was measured by pumping solutions, which varied in composition between .0001 m HCl and 4 × .0001 m KOH, and which were presaturated at 25 C with H2 at 1 atm, through a heated column containing Fe_3O_4 in a pressurized system. The dissolved Fe in the effluent solution was collected on an ion exchanger for later chemical determination. The solubilities, measured at temperatures between 50 and 300 C, were fit with a scheme. In acid and neutral solutions the overall solubility was found to vary inversely with temperature and alkalinity, but in the more alkaline solutions at high temperatures, the solubility varied in the opposite directions. The solubility data indicate that Fe_3O_4 columns used for purification in pressurized-water systems should be placed in the high temperature zone if the solution is neutral, and in the low temperature zone if the solution is alkaline. Observed behavior of cruds in loops and reactor systems were compared with the observed solubility of Fe_3O_4. Author (NSA)

N70-19358# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
TIME-SHARING FORTRAN PROGRAM FOR THE DYNAMIC ANALYSIS OF GASES BY TIME-OF-FLIGHT MASS SPECTROMETRY
Robert W. Loser, Carey A. Chambers, Evain D. Ruby 7 Nov. 1969 15 p
(Contract AT(29-1)-1106)
(RFP-1400) Avail: CFSTI

A time-sharing FORTRAN program is presented for use with a fast scanning mass spectrometer. The program processes mass spectral data to determine the rate at which gases evolve from a solid sample and the total quantity of gas evolved. Calibration data and mass-peak measurements are described as input data.

Gas flow rate and gas quantity are described as output data. A description of the gas analysis technique is presented along with the numerical methods used to reduce the mass spectral data. A description of the time-sharing FORTRAN program is also presented
Author (NSA)

N70-19403 Georgia Inst. of Tech., Atlanta.
MOBILITIES, DIFFUSION COEFFICIENTS, AND REACTION RATES OF MASS-IDENTIFIED NITROGEN IONS IN NITROGEN
John Travis Moseley (Ph.D. Thesis) 1969 266 p
Avail: Univ. Microfilms: HC $12.15/Microfilm $3.45 Order No. 69-4514

The drift velocities and mobilities of mass-identified N(+), N2(+), N3(+), N4(+) and K(+) ions in nitrogen gas at 300 K and at pressures on the range from 0.03 to 1.00 Torr have been determined as a function of E/N, where E is the electric field strength and N is the gas molecule number density. Both the longitudinal and the transverse diffusion coefficients for N(+), N2(+), and K(+) ions in nitrogen have been measured as a function of E/N at the same temperature and on the same pressure range. The rates for the ion-molecule reactions have been obtained at near thermal energy and at moderately high E/N. Dissert. Abstr.

N70-19418# Scientific Translation Service, Ann Arbor, Mich.
CALCULATION OF THE KINETICS OF AMMONIA RADIOLYSIS IN THE GAS PHASE. 3: STATIONARY HYDRAZINE YIELD IN THE RADIOLYSIS OF ETHYLENE-AMMONIA MIXTURES [RASCHET KINETIKI RADIOLIZA AMMIAKA V GAZOVOI FAZE. 3: STATSIONARNYI VYKHODA GIDRAZINA PRI ETILEN-AMMIACHNYKH SMESEI]
B. G. Dzantiev et al Nov. 1969 10 p refs Transl. into ENGLISH from All-Union Inst. of Sci. and Tech. Inform. (USSR), no. 687-69, 1969 12 p Sponsored by AEC Prepared for Argonne Nat. Lab., Ill.
(ANL-Trans-786) Avail: CFSTI

A mechanism is proposed for the radiolysis of ethylene-ammonia mixtures which permits the explanation of the linear dependence of the stationary hydrazine yield on pressure and the absence of a dependence of alpha (max) on p as observed experimentally (under conditions when the dose rate is a linear function of pressure).(Alpha = ethylene concentration and p = pressure.) The hydrazine yield increased by two orders of magnitude at the optimum ethylene concentration when compared with the value of the yield in pure ammonia when the ethylene-ammonia system was irradiated with Co-60 gamma rays. The decreasing effectiveness of ethylene additions in passing from light to heavy particles is apparently related to the fact that the spatial distribution of the primary radiolysis products causes not only a predominant recombination of NH2 radicals, but also decreases the role of hydrogen atoms in the decomposition of hydrazine. NSA

N70-19428# Atomics International, Canoga Park, Calif.
STUDIES OF THE SOLUBILITY OF IRON IN SODIUM
P. L. Eichelberger and R. L. Mc Kisson 15 Aug. 1969 26 p refs
(Contract AT(04-3)-701)
(AI-AEC-12834) Avail: CFSTI

The solubility of iron in high-purity sodium was studied in the temperature range of 500 to 1000 C, using both unirradiated and irradiated iron as solute. No explanation was found for the variable divergence of colorimetric and radiochemical results, or for the relatively poor reprodudicibility, although the factors which may affect such experiments are discussed. The most probable value for the solubility of iron in sodium, in the temperature range studied, is of the order of 1 wppM, but the data do not permit a calculation of the temperature dependence. Author (NSA)

N70-19433# Oak Ridge National Lab., Tenn.
THE STABILITY OF URANIUM TRIFLUORIDE. PART 1. STABILITY IN THE SOLID PHASE
G. Long and F. F. Blankenship Nov. 1969 28 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2065-Pt-1) Avail: CFSTI

The equilibrium pressures of HF produced in the reversible reaction UF4(c) + 1/2 2H2(g) yields Hf(g) + UF3(ss) (with UF3 in solid solution with UF4) were measured over the temperature range 565 to 889 C. From the data, with corrections for the formation of the solid solution, the difference in free energies of formation of UF3 and UF4 and the thermochemical properties of UF3 were derived. From measurements made above the melting point of the UF3-UF4 eutectic (892 C) deductions were made regarding the UF3-UF4 phase diagram. Author (NSA)

N70-19442 Syracuse Univ., N.Y.
A SPECTROSCOPIC INVESTIGATION OF HYDROGEN BONDING IN BUTANEDIOL
Tun-li Chen (Ph.D. Thesis) 1968 90 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-7727

An experimental study of the hydrogen bonding in butanediols is presented. Infrared spectra, especially in the O-H stretching region, were recorded for pure samples, dilute solutions in CCl4 and CS2, and in the vapor phase over a temperature range of 25 C to 300 C. The frequency of the intermolecular hydrogen bond in the pure sample had an expected high temperature dependence. The intramolecular hydrogen bond, evident in dilute solution, showed a weaker temperature dependence. The value of temperature dependence for the intramolecular hydrogen bond depends on the solvent and on the particular diol. The increments for intramolecular hydrogen bond formation were determined in dilute solution and the vapor phase by the usual relative peak height method. These were also compound and phase dependent. Dissert. Abstr.

N70-19443 University of Southern Calif., Los Angeles.
KINETICS AND CONFIGURATIONS OF COBALT (III)-BISDIMETHYLGLYOXIME COMPLEXES
Hon Gee Tsiang (Ph.D. Thesis) 1969 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-9044

The rate of displacement of water in Co(DH)2(SO3).OH(-)2 where DH represents the dimethylglyoximate anion, was studied at 25 C in sodium perchlorate medium at unit ionic strength by various nucleophiles. The numerical values of the second order rate constants for the various nucleophiles are thiourea, 8.34/M/sec; N(-)3, 7.30/M/sec; HSO(-)3, 6.06/M/sec; I(-), 5.50/M/sec; pyridine, 5.00/M/sec; and S2O3(-2), 1.45/M/sec. Ligation by I- does not proceed to completion. The equation rate of CO(DH)2I(-2) was found to be 2.15 from linear plots of the pseudo-first-order rate constants versus the concentration of iodide. Dissert. Abstr.

N70-19458# California Univ., Livermore. Lawrence Radiation Lab.
PHYSICAL METALLURGY: SELECTION OF THE TERNARY DIAGRAM U-O-N BY THE PLANE UO2-U2N3
Pierre-L. Blum et al 1969 5 p refs Transl. into ENGLISH from C. R. Acad. Sci., Ser. C (Paris), v. 268, no. 2, 13 Jan. 1969 p 148-151 Sponsored by AEC
(UCRL-Trans-10385) Avail: CFSTI

The cross section UO2-U2N3 of the ternary diagram U-O-N was described precisely by means of x-ray diffraction at high temperature. This is a pseudobinary system presenting a monotectoid at 1070 C for a composition corresponding to UON0.75. Furthermore, the existence of a four-phase reaction: U2N3(ss) = UN(ss) + UO2(ss) + N2 is demonstrated. Author (NSA)

N70-19505 Stanford Univ., Calif.
THE CONFIGURATIONAL STATISTICS OF POLYLACTIC ACID, PART 1. OPTICAL ANISOTROPY IN VINYL POLYMERS, PART 2
Alan Edward Tonelli (Ph.D. Thesis) 1968 207 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-8286

From the nature of the nonbonded interactions and chain geometry, it is shown that the mutual orientation of a given pair of adjoining virtual bonds is independent of the orientation of each of the other virtual bonds in the chain. Consequently, the configurational characteristics of the poly-L-lactic acid chain can be treated as a collection of independent L(+)-lactide units. Also, it is shown that the configurational characteristics of polylactic acid can be approximated if each lactide unit is assumed to have a confirmation corresponding to either of two conformational energy minimal. Measurement of the stress-optical coefficient, but not the depolarization ratio, provides a sensitive probe with which to determine the stereo regularity of vinyl polymers. Instead of the depolarization ratio, which is shown to vanish for flexible vinyl polymer chains with molecular weights on the order of several hundred thousand, measurement of the vertical component of light scattered at 90 deg from a horizontally polarized incident beam is indicated as a means of estimating the stereoregularity of vinyl polymers in dilute solution. Dissert. Abstr.

N70-19512# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
DETERMINATION OF FREE HYDROGEN FLUORIDE IN NONVOLATILE METAL FLUORIDES BY GAS-LIQUID PHASE CHROMATOGRAPHY
Laurence R. Ogletree 12 Sep. 1969 8 p refs
(Contract AT(29-1)-1106)
(RFP-1296) Avail: CFSTI

Gas-liquid phase chromatographic (GLC) determinations of hydrogen fluoride in nonvolatile metal fluorides were investigated in order to establish a direct method for free hydrogen fluoride in products from the fluoride volatility system. The GLC method is feasible for such a system, allows determinations to be performed on a routine basis, and can be adapted to the automatic operation of process streams. Hydrogen fluoride (HF) detection limits ranged from 0.008 by weight to 2.50 percent by weight. The relative reproducibility of the method on samples in the 0.01 to 0.04 percent of HF by weight range varied from 4 to 12 percent. The method, however, has a relative reproducibility of better than 4 percent on samples containing free hydrogen fluoride in concentrations of greater than 0.05 percent by weight. Author (NSA)

N70-19513# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
DETERMINATION OF MOISTURE IN NONAQUEOUS PLATING SOLUTIONS
Roger S. Cichorz 29 Aug. 1969 7 p refs
(Contract AT(29-1)-1106)
(RFP-1297) Avail: CFSTI

Water can be determined quantitatively in dimethyl sulfoxide, ethylene glycol, nonaqueous copper-plating solution and nonaqueous nickel-plating solution by measurement of the 1.94-micrometer water (H2O) combination band. Essentially linear Beer-Lambert calibration plots are obtained for the 0.3 to 15 percent H2O by volume range. Results of the infrared method agree within 5% relative with those obtained by an independent gas chromatographic method. The relative precision of the infrared method in the 1 to 10 percent H2O volume range is + or -1%. Author (NSA)

N70-19575# Sussex Univ., Brighton (England). Chemical Lab.
PROBLEMS RELATING TO AMIDO-DERIVATIVES OF METAL AND METALLOIDS Final Technical Report, May 1968-Apr. 1969
D. J. Cardin, S. A. Keppie, M. F. Lappert, J. S. Polani, A. R. Sanger et al Aug. 1968 199 p refs
(Contract DAJA37-68-C-1018)
(AD-696432) Avail: CFSTI CSCL 07/3

The synthesis of novel amides of Ti(III) and V(IV) are described. The reactions of dialkylamides of Li, B, Si, Ge, Sn(IV), Ti(III), Ti(IV), and Zr(IV) and Hf(IV) were examined. Among the substrates used were: (1) unsaturated compounds; (2) protic compounds; (3)fluorocarbons; (4) nitriles; (5) metal carbonyls; and (6) diazoalkanes. Reactions with diazoalkanes have provided novel organometallic diazoalkanes. These provide synthetic routes to organic heterocycles and azo-derivatives of transition metals. Oxidative additions of sigma-cyclopentadienyl metallates or of cyclopentadiene to transition metal carbonyl residues provide novel syntheses of transition metal cyclopentadienylcarbonyl metallates or hydrides. Author

N70-19580# California Univ., Berkeley. Lawrence Radiation Lab.
RADIOLYTIC OXIDATION OF THE PEPTIDE MAIN-CHAIN IN DILUTE AQUEOUS SOLUTION: CHEMISTRY OF THE PEROXY RADICAL, RCONHC(O2)R2
M. J. Kland-English, H. A. Sokol, and W. M. Garrison Jul. 1969 12 p refs Presented at 158th Natl. Am. Chem. Soc., New York, 7 – 12 Sep. 1969
(Contract W-7405-eng-48)
(UCRL-18983; Conf-690909-2) Avail: CFSTI

In the gamma radiolysis of peptides in dilute O2-saturated solutions, reactions of OH radicals at the main chain led to formation of the long lived peroxy radicals RCONHC(O2)R2. Subsequent reactions of these radicals led to main chain cleavage. A number of competing modes of degradation are involved. A proposed scheme of reactions accounts for the observed product stoichiometries. Author (NSA)

N70-19620# Scientific Translation Service, Ann Arbor, Mich.
STUDIES ON REMOVAL OF RADIOIODINE BY ACTIVATED CARBON. PART 1: ADSORPTION OF IODINE AND METHYL IODIDE ON ACTIVATED CARBON
Toshifumi Murata and Kunio Kamiya 1969 12 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi, (Tokyo), v. 11, 1969 p 138-143 Prepared for Oak Ridge Natl. Lab.
(ORNL-TR-2185) Avail: CFSTI

In order to obtain adsorption data for iodine and methyliodide at low partial pressures, helium gas containing iodine or methyliodide was passed through a small activated carbon bed, and the amount of iodine and methyliodide absorbed was measured. The specific adsorption of both iodine and methyliodide at temperatures from 50 to 400 C was determined, together with the rate of desorption and the amounts irreversibly adsorbed. From these results it was found that the rate of adsorption can be expressed by the equation given by Bangham, and the isotherms by that of Freundlich. The differential heats of adsorption were obtained through the use of Clausius-Clapeyron's equation. Author (NSA)

N70-19630# Tuskegee Inst., Ala. School of Engineering.
DENSITY DETERMINATIONS USING A GAMMA RADIATION ATTENUATION TECHNIQUE Annual Report
I. G. Dillon 30 Sep. 1969 23 p refs
(Contract AT(40-1)-3604)
(ORO-3604-5; AR-3) Avail: CFSTI

Density measurements of coexisting vapor and liquid phases of alkali metals using a gamma attenuation technique were investigated. This technique was planned to be used at temperatures up to 2500 K. The performance of the technique for cesium up to 780 C was evaluated. NSA

N70-19844# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHOTOCHEMISTRY AND LUMINESCENCE OF PROTEINS
Yu. A. Vladimirov 1969 297 p refs Transl. into ENGLISH

from Izdatl'Stvo Nauka, (Moscow), 1965, 207 p
(AEC-TR-6717; TT-69-55013; IPST-CAT-5448) Avail: CFSTI

The contents of this book are presented in three parts: (1) lumines-of proteins; (2) migration of energy in protein systems and (3) photochemical processes in proteins and aromatic amino acids. A foreword, conclusion, and comprehensive bibliography are included. NSA

N70-19686# Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum.
LABELLING OF OILS WITH CARRIER-FREE CHROMIUM-51, MANGANESE-54 AND IRON-59
M. Michailov (Reactor Center, Sofia, Bulgaria) and H. Sorantin Nov. 1969 22 p refs Submitted for publication
(SGAE-CH-61/1969) Avail: CFSTI

Carrier-free Cr-51 and Mn-54 were produced from iron targets and Fe-59 from cobalt targets by fast neutron irradiation. After dissolution radionuclidic pure Cs-51 was obtained after removal of iron with isopropylether and chelating the Cr-51 with acetylacetone. The remaining Mn-54 could be rendered oil soluble by extraction with naphthenic acid, oleic acid, triolein or rape oil. Carrier-free Fe-59 was isolated from the Co-target solution by oleic acid. For the same purpose acetylacetone and isopropylether were used and the extract stabilized by neutralization with nenaphthenate. Backextraction of Fe-59 with water and reextraction with oleic acid was also possible. The methods described can be used for labelling mineral or vegetable oils with carrier-free Cr-51, Mn-54 or Fe-59. Author

N70-19693# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
ISOLATION OF RADIOCAESIUM FROM A FISSION PRODUCT MIXTURE BY MEANS OF SORPTION ON VANADIUM(4) HEXACYANOFERRATE
J. Krtil and J. Mencl Aug. 1969 8 p refs
(UJV-2242-CH) Avail: CFSTI

A method for isolation of Cs-137 from acidic solutions of fission products is described, in which vanadyl ferrocyanide is used as a selective ion exchanger for cesium. The method was verified by isolation of Cs-137 from a fission products mixture with yields about 99.9% and with the total accuracy + or -1%. Author (NSA)

N70-19694# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
DETERMINATION OF RADIOCAESIUM IN FISSION PRODUCTS BY MEANS OF QUANTITATIVE AND SUBSTOICHIOMETRIC EXTRACTION WITH NITROBENZENE SOLUTION OF LITHIUM DIPICRYLAMINATE
J. Krtil and M. Bezdek Aug. 1969 7 p refs
(UJV-2241-CH) Avail: CFSTI

Cesium was extracted from a fission product mixture at pH of approximately 8 in the presence of dilithium dihydrogen ethylenediaminetetraacetate (Li2Y) as the masking agent, by a nitrobenzene solution of lithium dipicrylaminate. Both quantitative and substoichiometric extraction were studied. The application for analysis of a fission products mixture is illustrated. Author (NSA)

N70-19695# Scientific Translation Service, Ann Arbor, Mich.
CALCULATION OF THE KINETICS OF AMMONIA RADIOLYSIS IN THE GAS PHASE. PART 1: HYDRAZINE YIELD AS A FUNCTION OF DOSE AND DOSE RATE [RASCHET KINETIKI RADIOLIZA AMMIAKA V GAZOVOI FAZE. 1: ZAVISIMOST'VYKHODA GIDRAZINA OT DOZY I MOSHCHNOSTI DOZY]
B. G. Dzantiev et al [1969] 13 p refs Transl. into ENGLISH from All-Union Inst. of Sci. and Tech. Inform. (USSR), 1969
Sponsored by AEC Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-784) Avail: CFSTI

In considering the kinetics of the radiative formation of hydrazine from ammonia, the following three ranges were distinguished; a range of linear time dependence of the radical concentrations and cubic time dependence of the hydrazine concentration; range of quasistationary values of the radical concentrations and linear time dependence of the hydrazine concentration; and range of stationary values of radical and hydrazine concentrations. The reactions that play a major role in the radiolysis mechanism and rate equations of the process are given. It was also found that since the nature of the dependence of hydrazine concentration on dose rate varies with time, the effects of dose rate on energy yield with different contact times are different. In the range of short contact times, the energy yield of N2H2 with increasing dose rate passes through a maximum. Data are tabulated. NSA

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N70-18307# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
DIAGRAMS FOR DESIGNING A MOVING-WINDOW RADAR
G. Grasso et al Apr. 1969 8 p refs Transl. into ENGLISH from Alta Frequenza (Milano), Vol. 37, 1968 p 971–973
Sponsored by Lincoln Lab., MIT
(Rept-159-69-363-ITLL) Avail: CFSTI

In an abbreviated form, analytical results are presented pertaining to the design of a detection radar with moving-window to be used on fluctuating targets. Once the number of impulses fired at the target and a certain false alarm probability are specified, the graphs shown yield rapidly the values of the signal to noise ratio required in order to obtain a certain detection probability and thus one finds the optimum digital threshold. Author

N70-18327*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Telecommunications Div.
RADIO FREQUENCY PERFORMANCE OF A 210-FT GROUND ANTENNA: X-BAND
D. A. Bathker 15 Dec. 1969 32 p refs
(Contract NAS7-100)
(NASA-CR-107931; JPL-TR-32-1417) Avail: CFSTI CSCL 17B

The 85 and 210 ft paraboloidal ground antennas of the Deep Space Instrumentation Facility were previously demonstrated to operate well below gain limit at S band. An 85 ft structure was recently evaluated at X band and found to remain below gain limit. The results of an abbreviated appraisal of the radio frequency performance of the Goldstone 210 ft advanced antenna system at X band show that in the good weather conditions encountered the aperture efficiency was in outstanding agreement with predictions. Both the surface tolerance of the reflecting system and the precision of the pointing system were found adequate for X band. It is concluded that a significant ground capability for weather dependent space communications or radio or radar astronomy is available at X band with this instrument. Author

N70-18509# Air Force Cambridge Research Labs., Bedford, Mass.
SELF-CONTAINED AUTOMATIC TRANSMITTING PACKAGE FOR LF SIGNALS: CONCEPT AND PRELIMINARY DESIGN FACTORS
E. A. Lewis, R. B. Harvey, V. C. Fields, R. B. Harrison, and C. B. Kalakowsky Aug. 1969 40 p refs *Its* Instrumentation Papers No. 159
(AD-696597; AFCRL-69-0352) Avail: CFSTI CSCL 17/2

A novel method is described whereby a high altitude aircraft can send emergency low frequency messages by dropping an

automatic device containing a parachute, antenna, transmitter, and power supply. The expected physical characteristics and performance are discussed on the basis of laboratory and field tests. Possibilities for deployment by rockets and balloons are also considered. Author (TAB)

N70-18580*# Booz-Allen Applied Research, Inc., Dayton, Ohio.
REQUIREMENTS FOR TRACKING RADAR FOR FALLING SPHERES
John L. Hain and William E. Brockman *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 175-185 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 17I

As a part of the system design of an upper air synoptic sounding system, a technique was developed for expressing explicitly the effect of pertinent radar accuracy limits on the uncertainties in the meteorological data produced by the system. The results of this aspect of the study are briefly reviewed herein. The passive falling sphere is the lightest and least expensive payload which has been shown to provide satisfactory data in the upper atmosphere, i.e., 30 to 100 km altitude. The usable data, however, come from a high-cost ground tracker of limited availability. The purpose of this paper is to explore the relation between the requirements for data on the motion of the sphere and selected sources of error in a radar tracker. The discussion will consist of three parts, covering: first, the sphere trajectory; second, some pertinent radar accuracy limits; and third, the consequent limits on density and wind accuracies. Since only certain limiting conditions are considered, the results are essentially boundaries rather than explicit statements of accuracies applicable to specific configurations. Author

N70-18588# Army Foreign Science and Technology Center, Washington, D.C.
THE DYNAMICS OF RADAR ECHO DEVELOPMENT IN CUMULONIMBUS CLOUDS
R. A. Anchugova 23 Oct. 1969 13 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 224, 1968 p 111-116
(AD-697361; FSTC-HT-23-680-69) Avail: CFSTI CSCL 17/9

Investigations on the development of radar echo from cumulonimbus clouds within a radius of 100 km were carried out at the experimental base at Voyeykovo in the summer of 1965 using a high sensitivity radar. The observations were conducted using N. F. Kotovs rational antenna elevation angle system based on the principle of the constancy of the relative deviation from the altitude of echo formation. Author (TAB)

N70-18670*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PREDICTED COMMUNICATION BOUNDARIES FOR EARTH ATMOSPHERE ENTRY OF THE APOLLO VEHICLE Final Report
Jun. 1969 72 p refs
(Contract NAS5-9978)
(NASA-CR-108090; CAL-AI-2187-A-17) Avail: CFSTI CSCL 17B

A semiempirical technique was developed to determine the electron density and collision frequency distributions in the plasma surrounding an Apollo vehicle during earth-atmosphere entry Utilizing the results of these calculations, the communications blackout boundaries for a carrier frequency of 2.287 GHz were constructed. Results are presented for an entry velocity range of 14,000 to 35,000 ft/sec. For any arbitrary entry velocity in this range, the altitude uncertainty band is + or - 5000 ft. Reaction rate coefficients for the important electron depletion reactions were experimentally determined at elevated electron temperatures. Values were measured for the reactions NO(+) + e(-) → N + O, N2(+) + e(-) [N + N, and O2(+) + e(-) → O + O. These rate coefficients were used in the nonequilibrium ionization calculations of plasma electron density and collision frequency. Once the electrical properties of the plasma were determined, the propagation of microwave signal transmission from the vehicle to the outer surroundings was examined. A parametric-type investigation was performed using the Apollo 501 flight data as representative of actual flight conditions of interest. The influence of antenna near field effects and antenna impedance mismatch on the microwave transmission were taken into account. Reasonable correlation was obtained between the deduced electron density profiles and those predicted on the basis of the flow field calculations. In addition, quantitative agreement between the predicted signal attenuation and the flight data was achieved. Author

N70-18698# Sylvania Electronic Systems-East, Waltham, Mass. Applied Research Lab.
F-LAYER REFLECTIONS AND ION EFFECTS IN THE PROPAGATION OF TERRESTRIAL ELF WAVES Research Report
Janis Galejs Oct. 1969 35 p refs
(Contract Nonr-3185(00))
(AD-697309; RR-580) Avail: CFSTI CSCL 17/2.1

During nighttime waves penetrate above the D-layer and propagation parameters of the earth-to-ionosphere wave guide are dependent on the detailed ionospheric structure below the F-layer. The propagation characteristics are dependent on the altitude of the F-layer, electron density below this layer, the magnitude of the radial static magnetic field component, and also on ions that tend to increase the absorption of the penetrating magneto-ionic mode. The individual models advanced for the ionosphere are not representative of long distance or global wave propagation; but the average of the propagation parameters derived for a number of propagation geometries is comparable to the parameters deduced from an isotropic ionosphere model, where waves are confined to altitudes below 100 km. Author (TAB)

N70-18707*# TRW Systems Group, Redondo Beach, Calif.
SUBCARRIER EXTRACTION SYSTEM Final Report
Dec. 1969 68 p
(Contract NAS9-10229)
(NASA-CR-102174; TRW-14810-6001-T0-00) Avail: CFSTI CSCL 17B

Designed and tested were two amplitude phase extractor units capable of removing subcarriers at 1.024 MHz and 1.25 MHz from a TV baseband spectrum in order to hold spectrum disturbance to a minimum. Relative levels between TV baseband spectrum, the two subcarriers, and the overall signal to noise ratio at lunar distance indicated that both the subcarrier spectra were 25 to 35 dB greater than the TV spectrum. It was shown that a suppression of 20 dB was sufficient to reduce subcarrier signals to a level comparable with the noise level at an effective bandwidth of 100 kHz or less. With this suppression, the extractor bandwidths can be made narrower, thereby minimizing the extent of TV spectrum modification. G.G.

N70-18708*# TRW Systems Group, Redondo Beach, Calif.
ANALYSIS OF THE SPURIOUS SPECTRAL COMPONENTS APPEARING ABOUT THE S-BAND CARRIER
Patrick J. Ready 9 May 1969 83 p
(Contract NAS9-8166)
(NASA-CR-102172; TRW-11176-H188-R0-00) Avail: CFSTI CSCL 09F

The basic telemetry PM/PM modulation process used on command system model downlink S-band PM modes and lunar module downlink PM modes has been studied in this report. The results of the study indicate that TM spurs will be present in the signal spectrum of each CSM and LM mode listed above and will also be present whenever the S-band carrier is phase modulated with a filtered, biphase modulated subcarrier. The spurs have been shown to be located at integral multiples of the TM bit rate about the S-band carrier and their amplitude relative to the S-band carrier

to be a function of: (1) the TM subcarrier modulation index; (2) the subcarrier filter bandwidth; and (3) the TM bit rate. The expression relating the above three parameters to the S/C ratio has been derived, and a table of S/C ratios have been provided. A technique capable of producing significant reductions in the S/C ratio (in addition to an increase in the S-band carrier power) has been proposed. Reductions of approximately 25dB in the S/C ratio have been shown to be possible with existing Apollo CSM and LM parameters. Author

N70-18742*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
AN INVESTIGATION OF S-BAND SIGNAL TRANSMISSION THROUGH AN APOLLO EARTH-ENTRY PLASMA
Donald W. Boyer Jun. 1969 38 p refs
(Contract NAS5-9878)
(NASA-CR-108128; CAL-AI-2187-A-11) Avail: CFSTI CSCL 17B

An investigation was made of signal transmission at S-band through an Apollo earth-entry plasma environment. A plasma profile is described which is consistent with numerical predictions of the Apollo flow field and which results in computed signal attenuation behavior in qualitative agreement with data recorded from the AS-501 fired entry flight of an Apollo Command Module. The study indicates that plane-wave considerations alone are inadequate and that antenna impedance variation effects must be included to afford a quantitative correlation with observed attenuation behavior. The considerations include the effect of a dielectric aperture window on the calculated far-field transmission loss as well as an indication of the effect of radiation propagation angle on the shape of the received S-band signal. Author

N70-18892*# Research Triangle Inst., Durham, N.C. Engineering and Environmental Sciences Div.
AN ANALYTICAL INVESTIGATION OF ACQUISITION TECHNIQUES AND SYSTEM INTEGRATION STUDIES FOR A RADAR AIRCRAFT GUIDANCE RESEARCH FACILITY
C. L. Britt, W. S. Thompson, and L. S. Miller Jan. 1970 81 p refs
(Contract NAS1-8912)
(NASA-CR-66891) Avail: CFSTI CSCL 17I

The basic tracking accuracy of the GSN-5, as evaluated through boresight camera records, is within the specified accuracy and expected performance for a radar of this type. The data taken during this phase did not permit a conclusive evaluation of the basic range tracking accuracy. Analyses show that the basic GSN-5 RMS angular tracking accuracy varies between 0.5 and 6 feet at one half mile range and between 2.5 to 5 feet at 2 1/2 mile ranges. These data were reduced from boresight camera records over five second intervals with a data rate of 16 samples per second. These figures represent the basic tracking capability of the GSN-5 and do not contain errors arising in the data processing, parallax correction and coordinate conversion subsystems. Comparisons of position data outputs from the GSN-5 with those from the FPQ-6 radar indicated relatively large position errors. At a range (x) of 2 1/2 miles, the data errors for the beacon track mode were approximately 150 ft. (1.1%) in the x coordinate, 40 ft. in the cross range (y) coordinate, and 60 ft. (7%) in the altitude (z) coordinate. Author

N70-19024# Congress. House. Committee on Science and Astronautics.
ASSESSMENT OF SPACE COMMUNICATIONS TECHNOLOGY: REPORT
Washington GPO 1970 37 p refs Presented to the Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., by the Subcomm. on Space Sci. and Appl., 3 Feb. 1970 *Its* Serial J
Avail: Subcomm. on Space Sci. and Appl.

This assessment of space communications technology resulted from a hearing before the Subcommittee on Space Science and Applications. Explored is the current state-of-the-art of communications satellites technology. An attempt is made to determine whether there exist any institutional barriers to the utilization of technological innovations generated by research and development supported with public funds. G.G.

N70-19115 Rutgers Univ., New Brunswick, N.J.
APPROACHES TO RELIABLE AND EFFICIENT DATA COMMUNICATIONS USING SEQUENTIAL DECISION PROCESSES
Jay Jerome Brandinger (Ph.D. Thesis) 1968 384 p
Avail: Univ. Microfilms: HC $17.35/Microfilm $4.90 Order No. 69-7525

The main purpose of this study was to determine whether self-adaptive communications systems perform more reliably and efficiently than non-adaptive ones under transmission disturbances of complex fading, multipath and noise. The feedback analysis was in terms of an n path transmission channel with different amplitudes, time delays, and phase shifts on each of the paths in addition to Gaussian noise. The feedback path was assumed noiseless and delayless. The process was shown to be of a Markov type when conditions were stationary and an evaluation was made for the special case of a binary, symmetric, coherent data communication system. It was shown that the use of sequential detection and feedback provided substantial gain over a non-adaptive system in n path Rayleigh, and Ricean fading plus Gaussian noise. The use of sequential detection provided added margins of performance under multipath conditions. Dissert. Abstr.

N70-19122 Wisconsin Univ., Madison.
COMMUNICATION THEORY OF TROPOSPHERIC-SCATTER CHANNELS
Sung Jai Sohn (Ph.D. Thesis) 1968 129 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 68-13663

The communication theory of tropospheric-scatter channels necessary to analyze the channel output signal and the physical channel structure and to advance communication systems technology is developed. The mathematical relation between the space volume density of the scattered power (i.e., physical channel structure) in an antenna pattern common volume and the input-output relation of the channel on the two coordinate space of time delay and Doppler shift (scattering function) is developed using line, surface, and volume integrations and the transformation of derivative and integration spaces. The components of the received signal which are scattered from different heights in a common volume are analyzed. A theory of tropospheric-scatter mechanism which assumes wave reflecting layers is advanced. Dissert. Abstr.

N70-19194*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPOSED RFI AND MULTIPATH SURVEILLANCE EXPERIMENT
J. W. Bryan Dec. 1969 26 p refs
(NASA-TM-X-63822; X-551-69-535) Avail: CFSTI CSCL 17B

An experiment for the measurement of the radio frequency interference (RFI) and the multipath environments between 136 MHz and 154 MHz is proposed. This experiment is designed to be flown with a Delta or Scout Packaged Attitude Control (PAC) spacecraft. The purpose of the experiment is to obtain as much measured RFI and multipath data as possible in order to permit the optimum design of a Tracking and Data Relay Satellite Systems (TDRS). A preliminary investigation has uncovered many potential RFI sources in the continental United States. The only practical method of determining the RFI environment is to perform a series of measurements of the received power and spectral content in the bands of interest. The proposed experiment will determine the available channels for most reliable transmission of information both in the 136-154 MHz TDRS to user frequency band, and whenever circumstances allow, multipath effects, using the ATS-III spacecraft as a source, will be observed and analyzed. Author

N70-19205*# Polytechnic Inst. of Brooklyn, N.Y. Electrical Engineering Dept.
DIGITAL COMMUNICATIONS TECHNIQUES Interim Report, 15 Sep. 1969-15 Feb. 1970
Raymond L. Pickholtz 1970 11 p
(Grant NGR-33-006-020)
(NASA-CR-108226; PIBEE-70-001) Avail: CFSTI CSCL 17B

Results are obtained for convolutional codes by extending some error bounding techniques. A unified treatment of erasure anf variable list decoding is developed for use in analyzing the performance of proposed practical algorithms for decoding using a list. The effects of intersymbol interference in digital communications are reduced by using error correcting codes rather than by linear operators using equalizers. Algorithms are developed for discrete, quantized processing of data. R.B.

N70-19302*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
L-BAND PERFORMANCE CHARACTERISTICS OF THE ATS-5 SPACECRAFT
Fredric Kissel Feb. 1970 73 p
(NASA-TM-X-63828; X-731-70-51) Avail: CFSTI CSCL 17B

Tests performed with the ATS-5 spacecraft have shown that, even though it is spin stabilized, essentially all of the original objectives can be met. The spacecraft operational characteristics have been measured, in a space environment, and the test results indicate that the system is functioning normally. Link calculations have been verified with test data and the utilization of a timing and synchronization unit allows accurate measurements to be made through the spacecraft during the time interval that the spacecraft antenna illuminate the earth station. Propagation tests have been performed which show that diurnal effects and short term fading at L-band are negligable (less than + or − 0.5 db). The test techniques described herein, together with the measured ATS-5 spacecraft operational characteristics, provide the basic information required in order to proceed with the development of tests to measure multipath effects. Author

N70-19351*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COST EFFECTIVENESS OF SPACECRAFT POINTING ANTENNAS
R. M. Dickinson 15 Jun. 1968 21 p refs
(Contract NAS7-100)
(NASA-CR-108206; JPL-TM-33-390) Copyright. Avail: CFSTI CSCL 17B

An analysis of the minimum telecommunication cost for data return at planetary distances using pointing antennas is presented. The system analyzed concerns only the related communications downlink portions of a spacecraft and the Deep Space Network ground stations and Space Flight Operations Facility. A solar-cell-powered spacecraft using either a programmed pointing or RF tracking antenna is assumed. Based upon the assumptions made, spacecraft RF tracking antennas are shown to be more cost effective than programmed pointing antennas for the return of greater than 10 to the tenth power bits of data from Mars or greater than 10 to the eighth power bits from Jupiter. The results of the analysis are sensitive to certain cost and performance assumptions, which are discussed in the memorandum. Author

N70-19459# Edgerton, Germeshausen and Grier, Inc., Boston, Mass. Eastern Science and Technology Div.
AN EXCITATION COEFFICIENT MATRIX FOR ATMOSPHERIC TRANSMISSION IN THE 0.32 TO 0.70 mu WAVELENGTH RANGE
R. J. Ouellette 29 Feb. 1968 41 p refs Sponsored in part by DASA Revised
(Contract AT(29-1)-1183)
(EGG-1183-435-Rev; B-3725A) Avail: CFSTI

A method is described for evaluating atmospheric transmittance in the 0.32- to 0.70-micron wavelength band for arbitrary locations of source and receiver in the 0- to 700-km altitude range. The formulation utilizes a detailed matrix of extinction coefficients as a function of wavelength and altitude, and includes (1) molecular (Rayleigh) scattering, (2) ozone absorption, (3) aerosol scattering, and (4) water vapor absorption. Input data appropriate to the Dominic high-altitude series are given special attention, and extinction coefficients for Starfish, Kingfish, and Checkmate are tabulated in the appendix. These coefficients and the atmospheric model are to be used to calculate transmission for Dominic events only when actual transmission measurements are lacking. Author (NSA)

N70-19463# Lockheed Missiles and Space Co., Palo Alto, Calif.
FREQUENCY-PHASE SYSTEM OF DISCRETE INFORMATION TRANSMISSION
D. I. Zelinskii et al 1969 4 p refs Transl. into ENGLISH from Prib. Sist. Upr. (Moscow), no. 11, 1969 p 50-51
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A simple data transmission system is reported. Its operating principle is based on utilization of the dependence between the change in phase shift and frequency in the frequency-selective circuits. Data are transmitted by eight frequencies, for which a channel with a 300Hz passband is utilized. The functioning of the transmission system which consists of a transmitter and a receiver is described. A graph of the frequency dependance of the number of carrier pulses is shown, and the frequencies utilized between 2700 and 3000 Hz with associated phase difference are tabulated. F.O.S.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N70-18312# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUESTION OF ALGORITHMIZATION OF CONTROL COMPUTERS FOR AIRCRAFT
N. T. Berezyuk 28 Mar. 1969 12 p refs Transl. into ENGLISH from Samoletostroenie i Tekhn. Vozdushnogo Flota (USSR), no. 10, 1967 p 43-46
(AD-696484; FTD-MT-24-510-68) Avail: CFSTI CSCL 1/3

A method of optimizing the algorithm used in control computers for flight instruments is presented, and the calculation variants for a maximum set of process data (G) are studied. Ignoring the number of cycles in each step (m), G represents the sum of the initial data of each arithmetic operator and the final results of the calculations of the operator. Three definitions are established: the contraction coefficient, the algorithm displacement rate, and the algorithm selection coefficient. An algorithm is selected from among equivalent algorithms which is called the optimum differential algorithm. The minimum operational circuit is based on this and is called the optimum integral algorithm. Two stages in the development of the problem are introduced, and an example is presented. Author (TAB)

N70-18320# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Computer Science.
CONSTRUCTING PROGRAMS AUTOMATICALLY USING THEOREM PROVING
Richard J. Waldinger (Ph.D. Thesis) May 1969 111 p refs
(Contract F44620-67-C-0058)
(AD-697041; AFOSR-69-2922TR) Avail: CFSTI CSCL 9/2

The paper describes a method by which programs may be constructed mechanically. The problem of writing a program is transformed into a theorem proving task. The specifications for the program are used to construct a theorem, the theorem is proved,

and the program is derived from the proof of the theorem. The specifications for the program are described as a relation between the input and output variables expressed in predicate calculus. Mechanical theorem proving techniques are used to prove the existence of output variables satisfying the specifications. Existence is proven constructively, so that embedded in the proof is a method to compute the desired output values. A program is extracted from the proof. Restrictions to Robinsons resolution principle are proposed so that only constructive proofs are produced. A proof of the soundness of the method is presented. It is also shown that programs for the entire class of recursive functions may be written by automatic program writing. Thus nothing is lost by restricting application of the resolution principle. An implementation of the method which writes LISP programs is described. Author (TAB)

N70-18362# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
INTERFACE MESSAGE PROCESSORS FOR THE ARPA COMPUTER NETWORK Quarterly Technical Report, 1 Jul.-30 Sep. 1969
Frank E. Heart Oct. 1969 16 p refs
(Contract DAHC15-69-C-0179; ARPA Order 1260)
(AD-696122; BBN-1890; QTR-3) Avail: CFSTI CSCL 9/2

We describe the test programs developed, the testing procedure used, and the technical problems encountered in installing the initial IMP. Also, we outline several new features that have been incorporated into the operational IMP program. Author (TAB)

N70-18371# Naval Research Lab., Washington, D.C. Ocean Sciences Div.
A SMALL MAGNETIC TAPE DATA STORAGE SYSTEM EMPLOYING INCREMENTAL TAPE ADVANCE
C. F. Dohne and J. I. Hoover *In its* Rept. of NRL Progr. Dec. 1969 p 12–15 refs (See N70-18369 07-34)
Avail: CFSTI

A system has been designed to collect and store digital data temporarily in a four-decade primary storage resister, and on command transfer the data to a seven-channel magnetic tape for permanent storage. The data can be retrieved from the magnetic tape by means of a tape processor. Micrologic integrated circuits are used extensively for reliability, low cost, and miniaturization. The system is small, lightweight, and suitable for field operations. Author

N70-18386# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISCRETE AUTOMATA WITH MULTIPLE LINES
V. B. Svechinskii 26 Mar. 1969 20 p refs Transl. into ENGLISH from the Proc. of the Mosk. Konf. Molodykh Uch. i Spetsialistov. Priborostr., SRE-FTD-DSTVA Avtomatiz. i Sistemy Upr. Tr., (USSR), 1964
(AD-696498; FTD-MT-24-50-69) Avail: CFSTI CSCL 09/2

The paper examines the problem of designing reliable discrete automatic machines from unreliable components. In particular, it is shown that it is possible to design a reliable computer with three-unit redundancy if the constraints placed on components are not too strict. A means of increasing computer reliability is to check the performance of the individual elements and to provide for recovery of the faulty elements. Several methods of introducing such checking and recovery operations are examined and the reliability of a computer with recoverable elements is assessed. A method of designing a computer with three-unit redundancy is proposed, which makes it possible to detect the failure of any of the elements and to continue operation by substitution (or recovery) of the faulty element. The results obtained are readily extendable to computers with higher-order redundancy. Author (TAB)

N70-18440# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THREE-DIMENSIONAL CURVES AND SURFACES FOR RAPID COMPUTER DISPLAY Technical Report, Jun. 1968-Apr. 1969
Theodore M. P. Lee Bedford, Mass. USAF 30 Apr. 1969 134 p refs
(Contract F19628-68-C-0379; ARPA Order-952)
(AD-696176; ESD-TR-69-189) Avail: CFSTI CSCL 9/2

Rational parameteric polynomial functions of second degree or higher provide a class of curves including all conic sections. They can be generated by an iterative process easily implemented in software or hardware. The numerical accuracy of the process is analyzed. Algorithms for the specification, display, and modification of the curve are presented. Such curves are represented in a homogeneous coordinate formulation convenient for computer applications. Three-dimensional surfaces composed of such curves are similarly convenient to use. Without recourse to trigonometric functions, such classical surfaces as spheres and toroids can be readily described. The ease with which translation, rotation and projective transformations can be applied is exhibited. In particular, we do not perform such transformations on the points of the surface to be displayed--upwards of several thousand--but rather upon the rather small set of numbers in a 4 x 4 x 4 tensor that represents the surface. These surfaces are intended to be used in an interactive, freeform computer-aided design system. In this direction we discuss the enforcing of continuity conditions and possible data structures for representing the surfaces. Author (TAB)

N70-18463# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A COMPLEX OF DEVICES FOR MICROFILMING AND INPUT OF INFORMATION INTO ELECTRONIC DIGITAL COMPUTERS FROM MICROFILM OF PUNCHED CARDS
V. E. Zelikovskii 30 Jan. 1969 31 p Transl. into ENGLISH from Nauchn.-Issled. Inst. Aeroklimatologii. Trudy (Moscow), no. 39, 1967 p 63-83
(AD-696486; FTD-HT-23-888-68) Avail: CFSTI CSCL 9/2

Equipment is briefly described for microfilming punchcards and introducing information from the microfilm into an electronic digital computer at speeds of 1.6, 10, and 100 cards/sec. Author (TAB)

N70-18471# RAND Corp., Santa Monica, Calif.
THE PARALLEL, PIPELINE, AND CONVENTIONAL COMPUTER
W. R. Graham Oct. 1969 9 p
(AD-696109; P-4221) Avail: CFSTI CSCL 9/2

The analysis of parallel and pipeline computers gives two quantitative bases for computer selection and program construction: the single stage and program execution times required by the two types of machines, and the single stage and complete program efficiencies. Author (TAB)

N70-18494# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE UMTs-10 GENERAL-PURPOSE DIGITAL COMPUTER
Yu. Shevchik 13 Feb. 1969 31 p refs Transl. into ENGLISH from Tsifrovaya Vychislitelnaya Tekhn. i Programmirovaniye (USSR), no. 2, 1967 p 25-39
(AD-696546; FTD-MT-24-450-68) Avail: CFSTI CSCL 9/2

The UMTs-10 general purpose computer has an original design without connecting joints and a very flexible internal logic structure obtained as a result of application of the principle of horizontal microprogramming. The design and logic structure of the machine and its negative (minus-binary) number system are described. The bases of programming are given. Author (TAB)

N70-18520# Army Electronics Command, Fort Huachuca, Ariz. Atmospheric Sciences Lab.
A FLEXIBLE FAST FOURIER TRANSFORM ALGORITHM

Ronald R. Stoner Aug. 1969 27 p refs
(AD-696431; ECOM-6046) Avail: CFSTI CSCL 9/2

An algorithm for the Fast Fourier Transform is presented which does not require that the number of data points be a power of two. A flow chart and FORTRAN IV computer program are appended. Author (TAB)

N70-18534*# Oakland Univ., Rochester, Mich. School of Engineering.
FORMAC SOURCE PROGRAM GENERATING THE EQUATIONS OF MOTION OF THE SEVEN ELEMENT STICK MAN
J. C. Hill *In its* Biosystems Eng. Res. 30 Oct. 1969 9 p refs (See N70-18528 07-05)
Avail: CFSTI CSCL 09B

Described is the computer source program for generating the equations of motion of the seven element stick man. Author

N70-18605# International Business Machines Corp., New York.
DESIGN OF A NUCLEAR DATA ACQUISITION SYSTEM
Robert N. MacDonald *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 155–172 refs (See N70-18594 07-22)
Avail: CFSTI

A multi-user nuclear data acquisition system has been designed for the IBM 1800 computer. The system is based on a control unit which allows most standard nuclear instrumentation, such as analog-to-digital converters or scalars, to be plugged directly to the interface with no modifications. By means of a diode pin matrix plugboard, the control unit can be reprogrammed to handle eight different configurations of up to fifteen components while the system is on-line. This can be accomplished without disrupting the experiments in progress. Data transfer takes place via a high speed data channel operating in the cycle steal mode. This minimizes data collection time and permits a higher burst data rate. The programming system (PALS) used is highly interactive, allowing multi-tasking on each of two priority levels, plus a background job. System resources, such as core storage and disk space, are allocated dynamically as they are requested by the user and returned to the system when a user's program exists. Author (NSA)

N70-18609*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REDUCTION OF MACHINE TIME IN DISCRETE ORDINATES CALCULATIONS
Robert E. Sullivan, Dahsoong Yu (Okla. Univ.), and Lynn K. Albers *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 234–246 refs (See N70-18594 07-22)
Avail: CFSTI CSCL 09B

Use of the two-dimensional Sn computer code for reactor kinetics calculations, TDSN, is discussed. Modifications to the angular and spatial quadratures to reduce required machine time are described. Input data requirements and sources are given. Convergence criteria, quadrature order, eigenvalues, and running times are tabulated. NSA

N70-18613# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
CARONTE: THE EURATOM SYSTEM FOR AUTOMATIC CONTROL OF LINKED CALCULATIONS
G. Buccari, G. Fattori, and C. Mongini-Tamagnini *In* Am. Nucl. Soc. Proc.of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 297–303 refs (See N70-18594 07-22)
Avail: CFSTI

The CARONTE modular system, which uses a flexible transfer data format, is discussed. The data sets, transfer program, test and input programs and control are described. The organization and applications of the system are discussed. NSA

N70-18614# Commissariat a l'Energie Atomique, Saclay (France).
THE CODNUC SYSTEM: A MODULAR SYSTEM OF SUBROUTINES FOR REACTOR CALCULATION
Jean-Paul Bayard and Roger Boudet *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 304–312 refs (See N70-18594 07-22)
Avail: CFSTI

The CODNUC modular system for reactor calculations is described in some detail. The data sequence, auxiliary system, and standard subroutines used with the system are described. NSA

N70-18615# Hitachi, Ltd., Tokyo (Japan). Nuclear Energy Div.
HITACHI NUCLEAR CODES CONTROLS SYSTEM, NCCS
T. Watanabe, K. Arai, and T. Noda *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 313–323 refs (See N70-18594 07-22)
Avail: CFSTI

The NCCS modular system for reactor calculations is discussed. The functioning and operation of the systems data manager, data pool, and subroutines are described. Flow charts for program execution and for the data manager are shown. Typical examples of input data and inter-module communications programs are given. NSA

N70-18616# DuPont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
JOSHUA: A REACTOR PHYSICS COMPUTATIONAL SYSTEM
H. C. Honeck, J. E. Suich, J. C. Jansen, C. E. Bailey, and J. W. Stewart *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 324–333 refs (See N70-18594 07-22)
Avail: CFSTI

A description is given of the orientation, organization, and operation of the JOSHUA computational modular system for third generation computers. Applications development for the JOSHUA system is outlined; facilities provided to the JOSHUA user are described. Interactions of named data, precompiler, and data management modules are summarized; terminal facilities are described. NSA

N70-18617# Argonne National Lab., Ill.
RECENT DEVELOPMENTS AND CAPABILITIES IN THE ARC SYSTEM
L. C. Just, P. Walker, and B. J. Toppel *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 337–343 refs (See N70-18594 07-22)
Avail: CFSTI

The definitions of the computational, directive, and system modules utilized in the ARC computational system are given. Subroutines and program modules are defined; program implementation and execution are described. Systems organization and libraries are outlined; object capabilities are discussed. NSA

N70-18620# Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Centro Studi Nucleari della Casaccia.
THE USE OF HYBRID COMPUTERS IN THE ITALIAN CNEN NUCLEAR PROGRAMME
A. Mathis *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 391-414 refs (See N70-18594 07-22)
Avail: CFSTI

Advantages and disadvantages in using either analog and digital computers for solution of dynamics problems for power reactors are discussed. Errors are analyzed as a function of error frequency for analog and digital integration. The uses of hybrid computers are discussed. The simulation of reactor cores and heat exchangers is described. NSA

N70-18622# Los Alamos Scientific Lab., N. Mex.
THE EFFECTIVE USE OF THE COMPUTER STORAGE HIERARCHY
Thomas L. Jordan and William J. Worlton *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 435–450 refs (See N70-18594 07-22)
Avail: CFSTI

Guidelines for the selection of a properly balanced hierarchy of equipment and the proper use of the storage hierarchy are discussed. Also, experience at LASL with extended core storage is described. NSA

N70-18624# DuPont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
DATA MANAGEMENT FOR MULTIACCESS COMPUTATIONAL SYSTEMS
J. E. Suich, J. C. Jensen, and H. C. Honeck *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 471–481 refs (See N70-18594 07-22)
Avail: CFSTI

Data and job management for the JOSHUA multiaccess computational system are described. The JOSHUA system at Savannah River Laboratory is intended for application to problems in the management of a nuclear reactor facility. FORTRAN is used. NSA

N70-18625# Atomic Power Development Associates, Inc., Detroit, Mich.
A BURNUP SYSTEM CONTROL AND CALCULATION METHOD
E. R. Volk, J. S. Gubkin, D. B. Wehmeyer, and C. S. Yeh *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 482–491 refs Sponsored by Edison Electric Inst., and Electric Power Ind. of Japan (See N70-18594 07-22)
Avail: CFSTI

A one- or two-dimensional burnup system for use with the multigroup diffusion code SCRAMBLE 3 is described. The burnup control criteria and burnup control methods are described. A flow chart for the combined burnup system—SCRAMBLE 3 code is shown. The calculational method used in the burnup system is described; the equations are given. NSA

N70-18634# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
THE USE OF THIRD GENERATION COMPUTERS IN MONTE CARLO CRITICALITY CALCULATIONS
N. F. Cross and E. C. Crume *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 650–658 refs (See N70-18594 07-22)
Avail: CFSTI

Use of third generation computers for application of Monte Carlo Methods to solution of criticality problems is discussed. The advantages of the large computers are related to the criticality calculations. Capabilities and execution of the KENO program are discussed; some of the search systems incorporated in KENO are described. NSA

N70-18636*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COHORT-2: A MONTE CARLO GENERAL PURPOSE SHIELDING COMPUTER CODE
Leonard Soffer and Lester C. Clemons, Jr. *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 676–685 refs (See N70-18594 07-22)
Avail: CFSTI

The COHORT code was greatly reworked and modernized. It was integrated into a single package with more flexible geometry and biasing. The basic mechanics of the code were checked out for several problems, and it is presently operable on the IBM-7094. Author (NSA)

N70-18695*# Applied Research Lab., Waltham, Mass.
MULTIPAC, A MULTIPLE POOL PROCESSOR AND COMPUTER FOR A SPACECRAFT CENTRAL DATA SYSTEM. PHASE 2 Final Report
Thomas E. Baker, Gene A. Cummings, and Robert L. South Oct. 1969 229 p refs
(Contract NAS2-3255)
(NASA-CR-73348; F-7159-1) Avail: CFSTI CSCL 09B

MULTIPAC is a computer designed especially for use an an off-the-shelf central data system for deep space probes. This computer has the unusual characteristic that it may be repaired during flight through the command and telemetry link by reprogramming around the failed unit. This reprogramming is possible through a computer organization that uses pools of identical modules which the program organizes into one or more computers. The interaction of these modules is dynamically controlled by the program and not hardware. In the event of a failure, new programs are entered which reorganize the central data system. The only effect of such reorganization is to reduce the total processing capability aboard the spacecraft. Consequently, some low priority process may have to be eliminated, but data taking and transmission may continue. Author

N70-18745# Naval Postgraduate School, Monterrey, Calif.
DIGITAL ANALYSIS OF TURBULENCE DATA ON THE IBM 360/67 AT THE NAVAL POSTGRADUATE SCHOOL
J. R. Wilson, N. E. J. Boston, and W. W. Denner 1 Jul. 1969 99 p refs
(AD-696567; NPS-58DW9071A) Avail: CFSTI CSCL 4/2

A system of time series programs used by the Institute of Oceanography of the University of British Columbia was made available to the Department of Oceanography of the Naval Postgraduate School in February 1969. This report summarizes the system and outlines the procedures to be followed in using the programs. The system consists of three programs labelled UBC FTOR, UBC SCOR and UBC FCPLOT. The program UBC FTOR computes Fourier coefficients from selected channels of analog-to-digital tape and writes them on another tape. The program UBC SCOR reads the tape produced by UBC FTOR and from the Fourier coefficients calculates spectra, cospectra and quadrature spectra for the channels indicated. These are computed for each data block. The printed output gives for each quantity the average, standard deviation and a number representing the trend over the blocks. In the case of co- and quad-spectra phase and coherence are also printed out. The program UBC FCPLOT provides a Calcomp plot of the spectra for qualitative analysis. Author (TAB)

N70-18774# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF SYNTHESIS AND PERFORMANCE OF SPECIAL PURPOSE COMPUTING SYSTEMS
V. D. Panasenko et al 26 Mar. 1969 18 p refs Transl. into ENGLISH from Tsifrovaya Vychislitel'Naya Tekhn. i Programmirovaniye (Russian), no. 2, 1967 p 83-90
(AD-696313; FTD-MT-24-509-68) Avail: CFSTI CSCL 9/2

General problems involved in the synthesis and performance of special-purpose multicomputer systems are discussed. Three trends in the organization of joint operation of computers are distinguished: (1) Joint operation of a few existing various general-purpose computers; (2) Joint operation of a few identical general-purpose computers; (3) A special-purpose computing system (SPCS) which may consist of different or identical computers. Parallel and sometimes series-parallel algorithms are most suitable for SPCS; their efficiency can be evaluated by the minimum algorithm length and the total number of required operations. These indices of performance of SPCA are considered: (a) productivity, i.e., the net machine time spent in solving a problem; (b) productivity ratio, i.e., the ratio of the time required to solve a problem by one

computer to the time required to solve the same problem by SPCS consisting of identical computers; (c) structural suitability of algorithm to SPCS; (d) utilization factor of SPCS; (e) complexity and economy of SPCS. TAB

N70-18784*# Stanford Research Inst., Menlo Park, Calif.
TECHNIQUES FOR THE REALIZATION OF ULTRARELIABLE SPACEBORNE COMPUTERS Interim Scientific Report
J. Goldberg, M. W. Green, W. H. Kautz, K. N. Levitt, and James Turner Jun. 1968 188 p refs
(Contract NAS12-33)
(NASA-CR-86323; ISR-3) Avail: CFSTI CSCL 09B

The techniques developed are in support of computer structures in which reliability is achieved through autonomously controlled logical reconfiguration and fault masking. The organization of a reconfigurable microprogrammed processing unit is described. Techniques are presented for detecting a large class of memory system failures and for reconfiguring the memory so that faculty sections are not addressed. Additional design techniques are presented for commutation networks. The programming problems attendant to the achievement of ultrareliability are identified, and programming techniques are outlined for the detection and correction of failures and for the recovery from failures. The diagnosis of networks appropriate to a reconfigurable processor is considered, in particular, byte-sliced networks and commutation networks. Author

N70-18786*# Maryland Univ., College Park. Computer Science Center.
ON THE PARSING OF CONTEXT-FREE LANGUAGES BY PUSHDOWN AUTOMATA
Victor B. Schneider Jul. 1968 35 p refs Presented at 6th Ann. Meeting of the Assoc. for Computational Linguistics, Urbana, Illinois, 25 Jul. 1968
(Grant NGL-21-002-008)
(NASA-CR-108142; TR-68-76) Avail: CFSTI CSCL 09B

A straightforward algorithm for converting context-free grammars into pushdown-store automata that accept their languages is demonstrated. To prevent the necessity of backtracking during the computation of an acceptor, an algorithm is presented for converting nondeterministic acceptors into deterministic acceptors. Those languages for which this backtracking elimination algorithm fails contain as a subset the ambiguous context-free languages. From considerations of machine topology, upper bounds on memory storage requirements and computational times are derived for this class of single-scan automata. The upper bound on memory storage is shown to be proportional to the length of the input string. The upper bound on computational time required for acceptance by these machines is also shown to be proportional to the length of input strings. Several detailed examples, drawn from the ALGOL grammar, illustrate applications of the ideas in this paper to the design of formal language translators. Author

N70-18891*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ASP ARTIFICIAL SCIENTIFIC PROGRAMMING
Robert Baxter and Edward Sullivan Feb. 1970 16 p
(NASA-TM-X-63819; X-641-70-39) Avail: CFSTI CSCL 09B

In this report, the artificial scientific programming language elements necessary to solve a system of first order ordinary differential equations are defined. A fifth order floating point version of Nordsieck's method is used to obtain solutions of first order initial value problems. Nordsieck incorporates iterative self starting, and automatic revision of the step length into an efficient general purpose method. Author

N70-18898# Texas Univ., Austin. Electronics Research Center.
DIFFERENTIAL MODE ANALYSIS AND SYNTHESIS OF SEQUENTIAL SWITCHING NETWORKS
John R. Smith, Jr. and Charles H. Roth, Jr. 28 Mar. 1969 120 p refs
(Grant AF-AFOSR-766-67)
(AD-697189; TR-63; AFOSR-69-1028TR) Avail: CFSTI CSCL 9/2

Standard methods for classification, analysis, and synthesis of sequential switching networks are inadequate for many networks which have edge-sensitive flip-flops as memory. A differential mode (DM) sequential machine is introduced as a model for such networks. Any network which can be modeled by a fundamental mode a synchronous (FMA) sequential machine can also be modeled by a DM machine, but the DM machine often requires fewer internal states. A DM machine can always be converted to a FMA machine, but usually the FMA model requires additional internal states. A general model for edge-sensitive flip-flops is defined from which an inhibited-toggle (I-T) flip-flop is derived. The I-T flip-flop, a general-purpose edge-sensitive flip-flop, has properties which result in logic savings for some network realizations. Edge-sensitive flip-flops are represented by two methods: (1) FMA flow table models are developed for the I-T and other well-known types of flip-flops. These models show that edge-sensitive flip-flops generally have hidden internal states. (2) The terminal behavior of the flip-flops is described by means of difference operators. Several methods of analysis for DM networks are given. A general method for synthesis of sequential switching networks using I-T flip-flops is presented. The network is first represented by a DM table and flip-flop input equations are derived from this table. Author (TAB)

N70-18904# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSACTIONS OF THE ALL-UNION CONFERENCE ON INFORMATION RETRIEVAL SYSTEMS AND AUTOMATED PROCESSING OF SCIENTIFIC AND TECHNICAL INFORMATION (THIRD)
8 May 1969 9 p refs Transl. into ENGLISH from the Russian
(AD-696483; FTD-MT-24-132-69) Avail: CFSTI CSCL 5/2

The research and development of information services within the USSR, reported at the 3rd All-Union Conference on information retrieval systems and automated processing of scientific and technical information, is discussed. Author (TAB)

N70-18918*# Michigan Univ., Ann Arbor. Electrical Engineering Dept.
THEORY AND DESIGN OF RELIABLE SPACECRAFT DATA SYSTEMS Quarterly Progress Report, 10 Aug. - 9 Nov. 1969
19 Dec. 1969 50 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952492)
(NASA-CR-108136; QPR-3) Avail: CFSTI CSCL 09B

The design of fault-tolerant sequential networks is considered in terms of Q-masking stuck-at faults in state-assigned sequential machines. The main theorem proven is that: given any reduced machine M' it is impossible to design a state assigned realization M of M' such that all single stuck-at Q faults are Q-masked. Development work on concepts of fault masking, detection, location, and diagnosis as applied to combinatorial networks continues and an algorithm is developed for the degree of fault masking in classical redundancy schemes. G.G.

N70-18971# Aeronautical Research Labs., Melbourne (Australia).
A DATA ACQUISITION SYSTEM SUITABLE FOR AIRBORNE APPLICATIONS
K. F. Fraser Jul. 1969 78 p refs
(ARL/ME-126) Avail: CFSTI

Techniques applicable to airborne data acquisition and recording are reviewed. From this review a system which allows simultaneous recording of analog and digital data with a single analog tape machine has been designed conceptually. The system will accommodate with appropriate accuracy most data acquisition

and recording requirements which arise in the testing of aircraft. Simultaneous recording of flight crew commentaries on the same magnetic tape recorder is readily performed. Analysis of the recorded data requires the use of analog replay equipment in conjunction with a digital computer. Author

N70-18993*# General Instrument Corp., Salt Lake City, Utah. Microelectronic Div.

DIGITAL DATA SAMPLING MODULES Quarterly Progress Report, 1 Apr. – 30 Jun. 1969

30 Jun. 1969 60 p refs

(Contract NAS8-30003)

(NASA-CR-105587) Avail: CFSTI CSCL 09B

The final design and initial fabrication efforts are reported for the microminiature sampling modules. The individual components and circuits are briefly described, and circuit diagrams and electrical and thermal characteristics are included. N.E.N.

N70-19010*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RAPIER: A FORTRAN 4 PROGRAM FOR MULTIPLE LINEAR REGRESSION ANALYSIS PROVIDING INTERNALLY EVALUATED REMODELING

Steven M. Sidik and Bert Henry Washington Feb. 1970 89 p refs

(NASA-TN-D-5656; E-4748) Avail: CFSTI CSCL 09B

RAPIER is a very flexible, easy to use, sophisticated multiple linear regression program which computes the variance-covariance matrix of the independent variables, regression coefficients, t-statistics for individual tests, and analysis of variance tables. The major value of the program is its comprehensiveness and options; a choice of three strategies for the variance estimate, an analysis of more than one set of response variables for the same independent variables, a backward rejection based on the first response variable, the use of weighted regression, computation of predicted values for any combination of independent variables, and a chi-square test for normality. Author

N70-19131# Sandia Corp., Livermore, Calif.

SHOCK CODE USER'S MANUAL. A COMPUTER CODE TO SOLVE THE DYNAMIC RESPONSE OF LUMPED-MASS SYSTEMS

V. K. Gabrielson and R. T. Reese Nov. 1969 86 p

(Contract AT(29-1)-789)

(SCL-DR-69-98) Avail: CFSTI

A user's manual for the SHOCK code is presented. The code was written for the numerical solution of transient dynamic problems which have been modeled as lumped-mass systems. The current CDC 6600 version of the code and the major changes which have resulted since the original report (SCL-DR-65-24) was issued are described. The code is written entirely in FORTRAN and constructed around the 6600 SCOPE operating system. Special emphasis is placed on input data requirements, options for describing nonlinear stiffnesses (springs), and sample problems. Author (NSA)

N70-19179*# International Business Machines Corp., Cambridge, Mass. Advanced Space Systems Dept.

CORRELATION OF GRAVIMETRIC AND SATELLITE GEODETIC DATA, PART 2 Interim Scientific Report, 11 Sep. 1967-29 Feb. 1968

Gerald A. Ouellette and Pasquale Sconzo 29 Feb. 1968 270 p

(Contract NAS12-598)

(NASA-CR-86327; CES-D181) Avail: CFSTI CSCL 09B

This appendix contains the graphical results obtained from the computer. Each graph depicts the positional errors resulting from the inclusion of a given value for one harmonic coefficient. The values used are the standard errors associated with each harmonic as published by Rapp. This was achieved by the use of the F factor. It will be noticed that a slight variation in this technique is required in the graphs for zonal harmonics through C sub 4,0. This is simply due to the fact tht these harmonics were included in the nominal trajectory. Included are some preliminary results parameterized with period (semi-major axis). The secular trend exhibited by many of the graphs is one which can be accounted for. Consequently, the prediction error in these graphs is considered to be given by the amplitude of the oscillation about the secular trend. Author

N70-19242# Argonne National Lab., Ill.

GEDANKEN: A SIMPLE TYPELESS LANGUAGE WHICH PERMITS FUNCTIONAL DATA STRUCTURES AND COROUTINES

John C. Reynolds Sep. 1969 70 p refs

(Contract W-31-109-eng-38)

(ANL-7621) Avail: CFSTI

GEDANKEN is a simple idealized programming language with the following characteristics: (1) Any value which is permitted in some context of the language is permissible in any other meaningful context. In particular, procedures and labels are permissible results of functions and values of variables. (2) Assignment and indirect addressing are formalized by introducing values, called references, which in turn possess other values. The assignment operation always affects the relation between some reference and its value. (3) All compound data structures are treated as functions. (4) Type declarations are not permitted. The functional approach to data structures and the use of references insure that any process which accepts some data structure may be implicit, i.e., it may be specified by giving an arbitrary algorithm for computing or accessing its components. Author (NSA)

N70-19282 Detroit Univ., Mich.

COURSE DEVELOPMENT IN NETWORK ANALYSIS WITH COMPUTER ORIENTATION

Michael Vincent Kelley (Ph.D. Thesis) 1968 192 p

Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-7026

A course in undergraduate electric network analysis that provides the theoretical foundation required to utilize the computer as a computational tool is described. Postulating the need for an awareness of the value to the computer to the analysis of electric networks does not imply that even a minor part of the course is dedicated to programming. Programming requirements for the course described were kept to an absolute minimum through the use of a subroutine package which was developed. The subroutines which are available permit the student to solve all the differential and state-variable equations encountered as well as those equations involving both real and complex matrices. The subroutines were written in FORTRAN 4 for use on the IBM 1410. Since the 1410 is not equipped to handle a complex mode, it is considered of significant value to have a set of subroutines which makes complex-matrix algebra a reality on this machine. Dissert. Abstr.

N70-19408 Oregon State Univ., Corvallis.

DISTRIBUTED LOGIC MEMORY COMPUTER FOR PROCESS CONTROL

John Edward Smathers (Ph.D. Thesis) 1969 121 p

Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-8064

An instruction set and programming examples are described for a distributed logic memory computer organization. The computer is designed to take advantage of the economies of very large-scale circuit integration. The low-ordered three bits of every memory word are arranged to identify a cell as one of eight possible types. A program instruction includes modifier bits which specify the types of cells on which the instruction is to operate. This facility enhances the efficiency of programs. The logic design of the cell

is complete enough to permit estimating gate count per cell. An analysis of the sensitivity of gate count to changes in the instruction set is included. A program simulation of the distributed logic memory computer assisted in its development and later permitted verification of programs written for the computer. The existence of a compiler permitted such programs to be written in a convenient, symbolic form. A data multiplexer is developed as a practical application for the distributed logic memory computer structure. The necessary data multiplexer program, which consists of about 100 instructions, is shown. Dissert. Abstr.

N70-19413# California Univ., Livermore. Lawrence Radiation Lab.
USER'S GUIDE TO THE PUBLISHER-ALTER PROGRAM
Frederick N. Fritsch, F. Joan Dickinson, and J. Dennis Lawrence 11 Jun. 1969 62 p refs Sponsored by AEC
(UCRL-50684) Avail: CFSTI

Publisher alter (PubAlt) is an alter routine for the Publisher program. This routine offers a convenient method for correcting and updating Publisher input stored on tape. Information is altered by English words rather than by card. PubAlt offers a variety of alter requests for flexible altering of text and sentinels. PubAlt may be used with any version of the Publisher program and may be interchanged between the CDC 3600 and CDC 6600 at any time. Author (NSA)

N70-19447# Institute of Nuclear Research, Warsaw (Poland).
A 10 MHz DECIMAL COUNTER WITH LOGIC GATES
R. Bayer, T. Koba, Z. Kulka, and M. Nadachowski 1969 18 p refs In POLISH
(INR-1052) Avail: AEC Depository Libraries

The design and performance of a 10 MHz decimal counter with a 1-2-4-8 code are described. The counter consists of four bistables and logic gates. The circuit has been used in the decimal registers of analog to digital converter. Author (NSA)

N70-19460# Institute of Nuclear Research, Warsaw (Poland).
MIXER CODE
T. Kulikowska 1969 51 p refs
(INR-1062) Avail: CFSTI

The MIXER code prepares the 26-group macroscopic constants in a form suitable for direct use in the one-dimensional criticality code EWA-TAPE. The program library is based on the 26-group Russian constants elaborated by L. Abagian et al. The MIXER library is stored on a magnetic tape. The code calculates a self-shielding correction making use of the self-shielding factors given in the Abagian's library for 300 K, i.e., the code in its present version is destined for calculations of cold systems only. The program is written in GIER-Algol 3 for the GIER computer with one magnetic drum and one unit of buffer memory/4K/. One magnetic tape station is needed during program operation. Author (NSA)

N70-19576# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
THE SADS PROGRAM: STATISTICAL ANALYSIS OF DATA SUBSETS
Alfred Hume and Alfred A. Brooks 9 Oct. 1969 345 p refs
(Contract W-7405-eng-26)
(CTC-19) Avail: CFSTI

The SADS program supplies a means for the statistical analysis of medium to large volumes of related alphameric and numeric data. Facilities are provided for recognizing subsets of the data and computing frequency counts, means, standard deviations, and regression analyses. Operations of the SADS program is controlled by a set of instructions written in an Algol-like language designed specifically for this purpose. Logical and arithmetic expressions are fully implemented and unlimited nesting is permitted at both the statement and expression level. Field addressing, which may be in terms of pointer words in the data record, is fully checked for invalidities. FORTRAN functions and subroutines may be called from the analysis program. Comparisons may be written using English words (e.g., disease names) which are automatically looked up in a user-supplied dictionary. A structured field is implemented that is designed specifically for representing and examining repetitive related data fields (e.g., autopsy data). NSA

N70-19594# California Univ., Livermore. Lawrence Radiation Lab.
AN INTRODUCTION TO THE LRL TEXT EDITING SYSTEM
Frederick N. Fritsch and Dennis J. Lawrence 11 Jun. 1969 40 p refs Sponsored by AEC
(UCRL-50682) Avail: CFSTI

The LRL Text Editing System is described beginning with a few historical notes. The structure, capabilities, and implementations of the three basic elements of the system are discussed, including the Publisher-a general-purpose report composition program; Publisher Alter Routine (PubAlt)-a text editing program designed to operate on Publisher input; and CIC chain tape-on overlay chain tape containing PubAlt and Publisher linked to a main control program. The system is written in the LRLTRAN language for the CDC-3600 and the CDC-6600. NSA

N70-19635# California Univ., Livermore. Lawrence Radiation Lab.
MEGACHANNEL PULSE HEIGHT ANALYSIS
J. B. Niday and L. G. Mann 5 Sep. 1969 14 p refs Presented at the Intern. Conf. on Radioact. in Nucl. Spectry., Nashville, 11-15 Aug. 1969 Sponsored in part by AEC
(UCRL-71839; Conf-690818-5) Avail: CFSTI

A megachannel analyzer for on-line sorting and examination of coincidence data is being developed. The system consists of a dual 4096-channel ADC, a PDP-9 computer, a CRT display, and bulk storage on fixed-heat disk and magnetic tape. Initially the disk will have 256 tracks, each holding 4096 × 18-bit words arranged in 128 sectors. The heads may be switched between sectors. For each coincidence event the PDP-9 will receive up to 24 bits of information. These bits determine the disk address whose contents must be updated according to the input information. It would be possible to store approximately 100 events/second in a 1 million word array by simply updating the entire array continuously in a linear fashion. However, a more efficient approach which processes only those disk sectors currently in need of updating is described. The disk address for each event is broken into information on track number, sector angle, and sorted according to sector angle into a buffer which has one location for each sector. Author (NSA)

N70-19646# California Univ., Livermore. Lawrence Radiation Lab.
A USER'S GUIDE TO THE PUBLISHER PROGRAM
Frederick N. Fritsch, Virginia C. Smith, and J. Dennis Lawrence 11 Jun. 1969 60 p refs
(UCRL-50683) Avail: CFSTI

A complete user-level description of the capabilities and operation of Publisher, a computer program used to write notes and reports, to update them, and to obtain multiple copies from information on punched cards or magnetic tape. This guide was published with the aid of Publisher and thus provides an illustrative example of the program. Author (NSA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N70-18323# Colorado Univ., Boulder. Dept. of Electrical Engineering.

POINT CONTACT INDIUM ANTIMONIDE DIODES FOR MILLIMETER WAVELENGTH DETECTION AT CRYOGENIC TEMPERATURES

John Keith Hobbs Aug. 1969 99 p refs

(Grant NSF GK-1723)

Avail: CFSTI

Point contact diodes of tungsten on indium antimonide were studied for their detection capabilities of millimeter wavelength radiation at cryogenic temperatures. The performance of the diodes tested was found to be slightly substandard compared to commercial diodes at these frequencies. However, the tungsten-InSb diodes made suitable detectors at liquid helium temperatures (4.2 K). The effects of varying the metal probe pressure were also studied, and it was found that for an increase in probe pressure past a certain point the polarity of the diode's output voltage would reverse. The effect was continuous with the diode's voltage gradually going through zero and changing sign for increasing pressure. Author

N70-18336# General Electric Co., Schenectady, N.Y. Research and Development Center.

CAPACITOR ANALYSIS. EVALUATION REPORT

Johan Blok 31 Jul. 1969 43 p refs

(Contract DAAK02-69-C-0107)

(AD-696508; S-69-1123) Avail: CFSTI CSCL 9/1

Capacitors become hot during operation due principally to dielectric losses in the capacitor dielectric. Heat pipes were used to extract this heat and thus permit the capacitor to operate at higher power levels. The capacitor/heat pipe geometry used in these experiments permits roughly a twofold increase in power level. It is anticipated that optimizing the heat transfer design will give as much as a 20-fold increase in power handling capacity. Author (TAB)

N70-18406*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONTROLLED DECELERATION SPECIMEN PROTECTION SYSTEMS FOR ELECTRODYNAMIC VIBRATION SYSTEMS

Lawrence L. Cook, Jr. *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 11–21 refs (See N70-18404 07-32)

Avail: CFSTI CSCL 09E

Electrodynamic vibration systems are usually equipped with a means of terminating a test very rapidly in case of an operator error, equipment malfunction, or a power outage. The device used to implement this protection is known as an armature protector or an amplifier protector. The armature protector discharges the energy stored in the power amplifier and short circuits the armature. It's function is to protect the shaker moving element or armature by preventing it from hitting the mechanical stops; however, it was not designed to protect the test specimen. In fact, when the protector is initiated, the specimen is subjected to possible damage due to the high deceleration levels generated when the armature is suddenly stopped. In order to prevent specimen damage, additional protection devices were needed. Accordingly, two controlled deceleration specimen protection systems were developed. The typical response data during the operation is given. The method used to effect controlled deceleration is to automatically insert a variable damping resistance across the armature. Author

N70-18412# International Business Machines Corp., Owego, N.Y. Federal Systems Div.

RESONANT BEAM HIGH G VIBRATION TESTING

B. A. Kohler *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 71–76 (See N70-18404 07-32)

Avail: CFSTI

Response data from early development vibration tests on the Saturn Switch Selector (a small unit that routes and controls command signals in the Saturn 5 booster) indicated that the internal components were exposed to 250-g acceleration levels in the 200- to 700-Hz frequency range. These g levels were higher than any levels previously experienced, and they far exceeded the levels to which component suppliers were expected to guarantee their product. As a result, a comprehensive component qualification program was begun to assure that components selected for the unit would operate in the high g-level vibration environment. Part of the qualification program called for simulation of the high acceleration levels, so a special resonant beam fixture was designed and built to extend the capabilities of existing vibration equipment. The design, development, and fabrication of the resonant beam fixture that allowed vibration tests up to 250 g at varying frequencies is reported. Author

N70-18432 National Lending Library for Science and Technology, Boston Spa (England).

CONVERSION PROCEDURES FOR HEATING IN EXPLOSION-PROOF THREE-PHASE MOTORS [UMRECHNUNGSVERFAHREN FUER ERWAERMUNGEN EXPLOSIONSGESCHUEZTER DREHSTROMMOTOREN]

U. Engel Aug. 1969 10 p refs Transl. into ENGLISH from PTB Mitt. (German), v. 79, no. 2, Apr. 1969 p 81–84

(NLL-SMRE-Trans-5750-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A method is given by which the output of three-phase, explosion-proof, induction motors for use in flammable atmospheres can be adapted to the relevant limiting temperature rises according to the temperature class. The method would permit simplification in the designing and testing of these motors. The theoretical principles for this method are explained and shown to be valid by experimental measurements. Author

N70-18436*# TRW Systems Group, Redondo Beach, Calif.

DESIGN, DEVELOPMENT, FABRICATION AND DELIVERY OF PROTOTYPE SILICON MONOLITHIC AMPLIFIERS Final Report, Jun. 1967–Jul. 1969

25 Jul. 1969 118 p refs

(Contract NAS8-20732)

(NASA-CR-102383; TRW-08863-6001-T0-00) Avail: CFSTI CSCL 09A

A monolithic differential operational amplifier was developed incorporating vertical NPN and lateral PNP transistor structures formed in a dielectrically isolated substrate. The amplifier is to be used in control system electronics for space vehicles. Emphasis was placed on electrical requirements which include: large output voltage swing, high open loop gain, low input dc errors, and low power dissipation. Data on the processing technology, circuit design, integrated circuit layout, testing, and evaluation are included. D.L.G.

N70-18450# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE PROBLEM OF THE INFLUENCE OF AUTOMATIC MONITORING ON THE RELIABILITY OF SYSTEMS WITH REDUNDANCY

T. D. Zolkover 2 Sep. 1969 11 p refs Transl. into ENGLISH from Akad. Nauk SSSR Sibirsk. Otd., Tr., (USSR), no. 1, 1966 p 96-100

(AD-696164; FTD-HT-23-291-68) Avail: CFSTI CSCL 9/5

Systems with active parallel redundancy in which reserve elements (RE) are controlled by check-and switchover (ChS) units is considered. A set of differential equations describes the reliability conditions in terms of failure rates and r sub m (probability that a branch failure is accompanied by elimination or self-elimination of RE). As a result, the probability of successful operation of the entire system is determined. These particular cases are considered: (1) failure rates are constant in time (exponential law of distribution of reliable-operation time); (2) a definite ratio of failure rates of RE and ChS; (3) reliability characteristics of RE and ChS do not

change when the number of branches changes; starting from a certain value of the redundancy rate, the probability of successful operation decreases. When the probability of RE self-elimination is sufficiently high, ChS devices are superfluous. TAB

N70-18460*# North Star Research and Development Inst., Minneapolis, Minn.
RESEARCH INTO THE FEASIBILITY OF THIN METAL AND OXIDE FILM CAPACITORS Interim Scientific Report
M. E. Browning, G. V. Jorgenson, and W. H. Graves Jan. 1969 64 p refs
(Contract NAS12-551)
(NASA-CR-107950; ISR-2) Avail: CFSTI CSCL 09A

Low energy radio frequency sputtering and vacuum evaporation, were utilized in a continuing investigation of the feasibility of producing thin metal- and oxide-film capacitors. Dielectric material systems examined in the development work included SiO2, Al2O3, TiO2, and lead zirconate titanate. SiO2 gave the best results even with its lower dielectric constant because it had higher deposition rates and more stable electrical characteristics than the other materials. In most cases, deposited aluminum was used as the electrode material. Electrical test characteristics of thin film dielectric capacitors were excellent at temperatures up to 300 C and for frequency ranges of 200 to 100,000 Hertz. The capacitors remained functional at 500 C, but with some deterioration in characteristics. A number of test systems were made up with multiple layers of dielectric film and metal-film electrodes, including systems containing as many as ten capacitive layers. Author

N70-18475# Naval Postgraduate School, Monterey, Calif.
COMPARISONS BETWEEN RADIATION HARDENED AND STANDARD INTEGRATED CIRCUIT AMPLIFIERS IN AN ELECTRON BEAM
Donald Frederick Lesemann (M.S. Thesis) Apr. 1969 46 p refs
(AD-696566) Avail: CFSTI CSCL 9/5

An investigation into the effect of radiation from a linear accelerator on two types of integrated circuit operational amplifiers was made. Dielectric isolation, thin film resistors and compensation diodes were used in one amplifier (micro A744). The other amplifier (micro A709) was fabricated using standard methods. The micro A744 amplifier, in its current stage of development, was found to be more susceptible to the effects of accumulated dose from high energy electrons than the micro A709 amplifier. Author (TAB)

N70-18565# Navy Underwater Sound Lab., New London, Conn.
IMPEDANCE PER UNIT LENGTH BETWEEN TWO LONG HORIZONTAL WIRES ABOVE THE EARTH'S SURFACE
Peter R. Bannister
(AD-697279; USL-1028) Avail: CFSTI CSCL 9/5

The external impedance per unit length of a long, elevated, horizontal line source and the mutual impedance per unit length between two parallel, elevated line sources are derived for the quasi-static range by employing image theory. The image theory and previously derived analytical results are in very good agreement throughout the quasi-static range. Author (TAB)

N70-18656*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PREVENTION OF ELECTRICAL BREAKDOWN IN SPACECRAFT
Fred W. Paul and Donald Burrowbridge 1969 103 p refs
(NASA-SP-208) Avail: CFSTI CSCL 09C

Many unusual problems arise when high potentials are used at reduced pressures, and not all of the basic mechanisms are well understood. A general knowledge of fundamental breakdown phenomena, with particular emphasis on gas discharges is presented. Some design techniques, principles, and practices that were employed successfully in space applications are included. The art of building high voltage systems has developed to the point where guidelines can be given to help the new designer avoid old problems. The problems and techniques of testing are also discussed, and a rudimentary checklist is included as a suggested aid in the ready review of specific design considerations and problem areas. A sample design specification is included. Author

N70-18683*# United Aircraft Corp., Trevose, Pa. Electronic Components Div.
VOLTAGE CONTROLLED MONOLITHIC OSCILLATOR Final Report, Jun. 1967-Mar. 1969
L. V. Colvson and T. V. Sikina 1 May 1969 68 p refs
(Contract NAS8-20692)
(NASA-CR-102436) Avail: CFSTI CSCL 09A

A voltage-controlled oscillator utilizing two silicon monolithic integrated circuit chips and a TaN thin film resistor chip was developed. The oscillator has a typical fixed frequency stability of 0.0002% per degree centigrade. A 1% modulation linearity was obtained over a + or - 15% frequency bandwidth. The basic oscillator operated successfully from 400 Hz to 8 MHz, with integrated components. The oscillator has two complimentary outputs that are compatible with TTL circuits. The complete oscillator is packaged in a 3/8 by 3/8 inch flat package. The oscillator consumes approximately 250 mw from a 14 volt supply, or 150 mw from an 11 volt supply. The details of the oscillator design, the device design and fabrication, and the assembly and test of the final oscillator are discussed. The information obtained forms a sound basis for future development that will provide for a higher performance, lower potential cost and reduced size voltage-controlled oscillator. Author

N70-18692*# Block Engineering, Inc., Cambridge, Mass.
ATTENUATED TOTAL REFLECTION ENHANCED PHOTOEJECTION FROM CATHODES Final Report
E. Robert Schildkraut and Thomas Hirschfeld 15 Jun. 1969 145 p refs
(Contract NAS2-4661)
(NASA-CR-73409) Avail: CFSTI CSCL 09A

The optical equations governing the interaction between radiation and an interface of two different media were investigated theoretically and confirmed by experiment. The work was carried on using pure metallic cathodes in the ultra violet regions of the spectrum and later proceded to an investigation of the alkali metals, extending the spectral sensitivity of the cathodes into the blue-visible regions of the spectrum. Quantum efficiency gains from 2 to a factor of 10 were observed and partial confirmation of the theoretical absorption of incident radiation vs incidence angle were obtained. Author

N70-18893 National Lending Library for Science and Technology, Boston Spa (England).
THE UTILIZATION OF CURRENT TRANSFORMERS FOR MEASURING THE LOAD CURRENT OF A POLYPHASE RECTIFIER [STOSOWANIE PRZEKLADNIKOW DO POMIARU PRADU OBCIAZENIA PROSTOWNIKA WIELOFAZOWEGO]
T. Sluszkiewicz et al Oct. 1969 15 p refs Transl. into ENGLISH from Pregl. Elektrotech. (Poland), v 42, no. 3, 1966 p 91-93
(NLL-RTS-5388) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupon

The position selection where the current transformers should be connected to the power circuit is discussed. The characteristics of six circuit types for load current measurements are reviewed: three systems in which the current transformers are installed on the supply side of the power transformer and three in which they are connected on the secondary side. The problems arising from a constant component of the current flowing in the transformer primary windings are analyzed. The circuit systems were verified under laboratory conditions. Author

N70-18738*# Fansteel Metallurgical Corp., Compton, Calif.
EVALUATION OF HERMETICALLY SEALED WET SLUG TANTALUM CAPACITORS
A. F. Busto Sep. 1969 128 p refs
(Contract NAS12-2004)
(NASA-CR-86325; Rept-993511-4) Avail: CFSTI CSCL 09A

Tantalum packages for wet slug tantalum capacitors, incorporating a glass-to-tantalum seal and a welded header-to-case seal, have been developed which exhibit hermeticity and resistance to reverse voltage. These two factors are mandatory where such capacitors are to be used in high reliability applications. Tantalum encased capacitors meeting the T-3 physical and electrical MIL specifications were produced to a nominal 60V, 65 microfarads and tested with burn-in, life, reverse voltage, incremental ambient step stress, temperature cycling and immersion and surge voltage tests to ascertain their reliability and weaknesses. All units were subjected to burn-in: 54 hours at 85 C, 18 hours at 125 C. Failure to endure the burn-in occurred in 48 per cent of the units of which 90 per cent failed due to electrolyte leakage in the glass seal. A minor redesign in the tantalum header thickness rectified the failure in the glass matrix. Author

N70-18755*# Texas Univ., Austin. Electrical Engineering Research Lab.
POINTING OF THE 16 FOOT ANTENNA
John H. Davis and J. R. Cogdell 15 Nov. 1969 37 p
(Grant NGL-44-012-006)
(NASA-CR-108124; NGL-006-69-3) Avail: CFSTI CSCL 09E

This paper develops a comprehensive pointing theory for the 16-foot antenna. The pointing of the antenna anywhere in the sky is related to the servo encoder readings through eight error parameters. It is shown that these eight parameters may be determined by an orderly sequence of simple experiments. Author

N70-18785*# Northrop Corp., Hawthorne, Calif. Electronics Div.
MINIATURIZED TIME CODE GENERATOR Final Progress Report
23 Jun. 1969 18 p
(Contract NAS4-1381)
(NASA-CR-108132; NORT-69-578) Avail: CFSTI CSCL 09E

Problems encountered and solved in the design, development, and production of a miniature time code generator are covered. Separate topics dealing with the time code generator and the setting control and test unit are discussed. Recommendations for future units are made. Photographs and specifications of the units are also given. Author

N70-18810# Army Foreign Science and Technology Center, Washington, D.C.
INTERACTION BETWEEN TWO TRAVELING WAVE ANTENNAS
B. Ya. Pavlov 24 Oct. 1969 13 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 29, 1968 p 3-7
(AD-697326; FSTC-HT-23-032-70) Avail: CFSTI CSCL 9/5

The interaction between two traveling wave antennas is examined. When the distance between antenna centers is approximately one wave length, interaction is low. In the case examined, the optimal phase velocity of the wave in the antenna is not equal to the optimal velocity for one antenna, but it depends on the distance between antennas. Author (TAB)

N70-18811# Army Electronics Command, Fort Belvoir, Va. Night Vision Lab.
HIGH-CURRENT ANODES FOR HIGH POWERED XENON ARC LAMPS Interim Technical Progress Report, Jun. 1968-Jun. 1969
Clifton S. Fox, M. P. Rebne Thomsen, and John A. Schmidtlein Aug. 1969 26 p
(AD-696478; Rept-4) Avail: CFSTI CSCL 9/1

In-house studies were made on the failure mechanisms of the positive electrodes (anodes) in xenon arc lamps with 20-KW to 40 KW power ratings. New materials, geometrical designs, and fabrication techniques were employed in experimental anodes and tested under operating conditions. Author (TAB)

N70-18857# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
A SEMICONDUCTOR GAUSSIAN WHITE NOISE GENERATOR
N. J. Steer Jun. 1969 38 p refs
(WRE-TN-PAD-173) Avail: CFSTI

This note describes the development and performance of a gaussian white noise generator using a linear integrated circuit amplifier as the primary noise source. For the frequency spectrum from 50Hz to 100 kHz, the root mean square voltage density of the noise can be made uniform to within + or - 1dB by means of a filter adjusted by a simple select on test procedure. From the analogue noise signal a random binary output signal is derived, operating between levels compatible with digital microcuits. For experiments involving detection of signals in noise, required signal-to-noise ratios may be produced in either analogue or binary form by adding the desired signal into the noise generator. Author

N70-18906 Illinois Univ., Urbana.
EXPERIMENTS AND THEORY ON THE CHARACTERISTICS OF METAL-OXIDE-SEMICONDUCTOR TRANSISTORS IN THE CURRENT SATURATION RANGE
Te-Long Chiu (Ph.D. Thesis) 1968 115 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-10660

A two section model theory is employed to analyze the characteristics of metal-oxide-semiconductor transistors operating in the current saturation range. In this theory, the device structure is divided into two sections: the source section and the drain section. Shockley's gradual channel approximation is assumed in the source section whereas the depletion approximation is assumed in the drain section, where the two dimensional potential distribution is considered. The solutions of the potential, the field intensity, and the drain current in these two sections are then matched at the boundary separating them to give a system of characteristic equations. The drain current, the transconductance, the drain conductance, and the amplification factor are then obtained from these characteristic equations. The saturation drain conductance for a long channel MOS transistor is found to be approximately inversely proportional to the drain voltage in excess of the gate voltage. The saturation drain conductance obtained from this theory is compared with that obtained from measurements and a good agreement is found. Dissert. Abstr.

N70-18930 National Lending Library for Science and Technology, Boston Spa (England).
A METHOD OF CALCULATING THE RATIO AND PHASE ANGLE ERRORS OF A CURRENT TRANSFORMER WITH A HIGHLY SATURATED CORE [METOD RASCHETA TOKOVOYI UGLOVOY POGRESHNOSTEY TRANSFORMATORA TOKA PRI GLUBOKOM NASYSHCHENII SERDECHNIKA]
K. S. Dmitriev et al Oct. 1969 18 p refs Transl. into ENGLISH from Elektrichestvo, (Moscow), no. 12, Dec. 1967 p 39-43
(NLL-RTS-5383) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d or 2 NLL photocopy coupons

An alternate method was investigated to assess current transformer errors when the core is highly saturated and assessment would be impracticle by equivalent sine-wave methods. The method is based on findings which show that when the core is highly saturated and the ratio error is large better agreement with experimental results can be obtained by substituting the actual magnetization characteristics of the current transformer core by a

rectangular magnetization curve without hysteresis. The formulation used in calculating the ratio and phase angle error is described and results obtained are compared to experimental values. Despite its simplicity, the proposed method is of satisfactory accuracy for calculating current transformer errors when the core is highly saturated and the calculated ratio error is greater than 20 to 25%. D.L.G.

N70-18949# California Univ., Los Angeles. School of Engineering and Applied Science.
INTERFACE PHENOMENA INTERGRATING CIRCUIT OXIDES Annual Report, 4 Mar. 1968-3 Mar. 1969
Cadambanguri R. Viswanathan Oct. 1969 36 p refs
(Contract DAAB07-68-C-0203)
(AD-697147; ECOM-0203-1) Avail: CFSTI CSCL 20/12

The instability in MIS devices, arising due to mobile positive ions in the insulator layer is investigated using photoelectric layer. A direct measurement of the built-in voltage in the MIS structure, viz., the voltage existing across the insulator due to interface effects, has been shown to be possible using the photoelectric technique. It was found that the built-in voltage differs by 0.85 volts between the degenerate n and p type samples under identical conditions. The built-in voltage is also a function of the spatial distribution of positive ions in the insulator layer. Using the values of the built-in voltage, interface photoelectric technique. It was found that the built-in voltage differs by 0.85 volts between the degenerate n and p type samples under identical conditions. The built-in voltage is also a function of the spatial distribution of positive ions in the insulator layer. Using the values of the built-in voltage, interface photoelectric threshold, the energy band diagram of the MOS structure is constructed. The feasibility of using the extension of long wavelength response of photodetectors using Franz-Keldysh effect was also studied. It was concluded that the shift is too small to be of any practical value. Author (TAB)

N70-18986 National Lending Library for Science and Technology, Boston Spa (England).
THE EFFECT OF DUST ON THE ELECTRICAL BREAKDOWN POTENTIAL
G. Berecz 30 Jul. 1969 7 p refs Transl. into ENGLISH from KFKI Kozlemen. (Budapest), v. 16, no. 2, 1968 p 137–143
(NLL-CE-Trans-5185-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A variety of pulverised materials were deposited on a Rogowsky electrode by electrostatic process and measurements were made in the pressure range between one and ten atmospheres. Investigations were extended to the humidity of the dust. By comparing the results obtained from the measurements with the decrease in the breakdown potential of dust free electrodes, it was found that the surface roughness below 0.8 microns does not affect deterioration of breakdown potential, and only above 4 microns was any noticable voltage deterioration found. The absorbent powders are more effective in decreasing the breakdown potential as their moisture content increases. Author

N70-18976*# Bendix Corp., Teterboro, N.J. Navigation and Control Div.
DESIGN AND DEVELOPMENT OF MICROELECTRONIC CIRCUITS FOR STABILIZATION OF A GAS BEARING GYRO SERVO LOOP Phase Completion Report
B. Friedman 11 Mar. 1968 112 p
(Contract NAS8-11916)
(NASA-CR-102453; MT-8256) Avail: CFSTI CSCL 09E

A servoamplifier was designed, built, tested, and evaluated for stabilizing a gas bearing gyro servo loop. The circuits in the amplifier were designed using microelectronic components wherever feasible in an effort to realize greater reliability along with volume and weight savings. Circuit diagrams are given of the preamplifier and detector, low pass filter, stabilizing networks, and the pulse width modulator power amplifier. The design of the power amplifier integrates a discrete component PWM design using custom integrated circuits as much as possible. The use of dielectric isolation to separate each of the active devices permits the design to be converted quite easily from discrete form to integrated form. Frequency characteristics of the stabilizing networks are described, and results of tests on components and circuits are given. N.E.N.

N70-18982*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ROTATING SHAFT-MOUNTED MICROELECTRONIC DATA SYSTEM
Daniel J. Lesco, John C. Sturman, and William C. Nieberding Washington Feb. 1970 25 p refs
(NASA-TN-D-5678; E-5170) Avail: CFSTI CSCL 09A

A data system, using commercially available microelectronics and a rotary transformer, mounts on and rotates with the shaft of rotating machinery at speeds to 15 000 rpm. As many as 72 channels of steady-state transducer signals are time-division multiplexed and converted to 8-bit binary words by the system. A rotary transformer couples power onto the shaft and binary data from the shaft. A version of this system was tested for use on an experimental jet engine. It exhibited a measured error of less than + or – 0.5 percent of the 50-mV full-scale input voltage. Author

N70-19019*# Columbia Univ., New York.
A SYSTEMS APPROACH TO DEVICE-CIRCUIT INTERACTION IN ELECTRICAL POWER PROCESSING Annual Status Report, 1 Jun. 1967 – 31 May 1968
T. E. Stern and E. S. Yang May 1968 15 p refs
(Grant NGR-33-008-090)
(NASA-CR-105589) Avail: CFSTI CSCL 09E

Research activities are summarized, and a list of published articles is presented. Periodically switched lossless networks were characterized and analyzed, and mathematical models of nonlinear resistive networks were developed. A tunable and bandwidth adjustable filter was developed to aid in the study of high power, high efficiency switched circuits. The use of a small-signal analysis was applied to a p-n-p-n tetrode for investigating its speed. A two-dimensional approach to the study of current density distribution of field effect transistors was initiated. N.E.N.

N70-19029# Naval Air Systems Command, Washington, D.C.
US NAVY RESEARCH AND DEVELOPMENT PROGRAMS ON LIGHTNING PROTECTION FOR AIRCRAFT
Emilo R. Rivera *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 18-22 (See N70-19027 07-02)
Avail: CFSTI

Early designs of shunt spark gaps to protect aircraft radio equipment from lightning discharges are discussed. Other methods to reduce lighning hazards include aluminum paint to protect radome structures and nose observer domes on patrol aircraft. Problems related to lightning protection of helicopters are described. R.B.

N70-19144# Weapons Research Establishment, Adelaide (Australia).
THE WRESAT TIMING UNIT
P. J. Oswald and D. N. Warren-Smith Jul. 1969 26 p refs
(WRE-TM-TSD-97) Avail: CFSTI

The Time Code Generator or clock provided a simple elapsed time code which was incorporated in the telemetry data transmitted from the satellite for the purpose of assisting in the task of correlating data received from the many tracking stations located around the world. Two identical units were built, one for testing purposes and as a backup should the other fail before launch and the other for use in the satellite. These units gave trouble free

performance both during the testing phases and in the mission itself. Telemetry data received from the Satellite established that the clock had operated correctly throughout the mission. The total weight of the unit was approximately 6 ounces and the total power consumption was 28 milliwatt. The elapsed time code was capable of providing an unambiguous readout for a period of more than 12 days with a resolution of half a second. Author

N70-19217# California Univ., Livermore. Lawrence Radiation Lab.
LINEAR SEVEN-DECADE CURRENT/VOLTAGE TO FREQUENCY CONVERTER
Edward G. Shapiro Jun. 1969 24 p refs Presented at the 16th Nucl. Sci. Symp., San Francisco
(UCRL-71766-Rev-1; CONF-691017-3) Avail: CFSTI

A current-to-frequency converter was developed for low level current measurements of wide dynamic range. It measures currents from 5 × 10 to the −13th power to 6 × .00001 amperes without range switching and by the use of state-of-the-art circuit components. It has a corresponding linear seven-decade transfer characteristic of 10 to the −11th power amperes per Hertz with a maximum output frequency of greater than 5 × 100,000 Hertz. The converter was designed to monitor photomultiplier tube current in an automated thermoluminescent dosimetry (TLD) system. Author (NSA)

N70-19229# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
PULSE COUNT CONVERTER SYSTEM
J. A. Miotke 23 Jun. 1969 33 p
(Contract AT(29-2)-656)
(GEPP-68) Avail: CFSTI

A pulse converter system is described that multiplies input pulses by a 4-digit factor, which is variable from 1.000 to 5.000 with resolution and accuracy of 0.001. The number of digits in the factor can be changed from four to any number between one and a limit set by clock frequency and input pulse rate. The decimal point can be changed easily to any location in the factor. In addition, the converter system performs as a pulse divider, if the factor is less than one, and it performs as a pulse adder for a factor of one. The converter has many applications in servo and pulse control systems. Author (NSA)

N70-19333# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
AUTOMATIC MOVEMENT DETECTION APPLIED TO A TELEVISION SURVEILLANCE SYSTEM
K. W. Boyle Aug. 1969 14 p refs
(WRE-TN-ED-177) Avail: CFSTI

An automatic movement detection system is described for use in conjunction with a television surveillance system. Any movement, or change in illumination, occurring in the scene under surveillance, causing a change in the picture being transmitted, results in alarm being raised. Features include a method of reducing the likelihood of false alarms and a means of matching detection sensitivity to the likely rate of movement of any person or object. Author

N70-19517# Institute of Nuclear Research, Warsaw (Poland).
DELAY PULSE GENERATOR /.00000110 SEC TO .0110 SEC/. THE CONSTRUCTION OF THE GENERATOR AND CONTROL MEASUREMENTS
Miroslaw Pryczek 1969 35 p refs In POLISH
(INR-1059) Avail: CFSTI

A description of the construction of a delay pulse generator in time range from 0.00000 1 to 0.01 sec is presented. The described generator is used in a phantastron circuit with switched delay ranges from 1 to 10 micro sec, 10 to 100 microsec, 100 to 1000 microsec, and 1 to 10 msec. Input and output of the generator are solved with regard to other electronic devices of the Capacitor Bank 150 kJ for plasma research. The control measurements give results of accuracy obtained for time delay, rise time, and amplitude of the output pulse and jitter time delayed pulses. Author (NSA)

N70-19665# Brookhaven National Lab., Upton, N.Y.
OVERLOAD RECOVERY CIRCUIT FOR CHARGE AMPLIFIERS
Veljko Radeka [1969] 12 p ref Sponsored by AEC
(BNL-14058) Avail: CFSTI

The operation of low noise charge preamplifiers under high instantaneous pulse rates or bursts is considered. An overload recovery circuit employing a field-effect transistor as the switch for the recovery current is described. The overload charge generated in the detector by the radiation burst in a time short compared to the small signal resolving time of the spectrometer may be 100,000 or more times larger than the charge due to a single particle to be measured between the bursts. The recovery time of the charge amplifier with the recovery circuit is less than 10 microseconds. With a conventional amplifier-filter, the recovery time of the system to within the noise level is 50 to 100 microseconds. The increase in noise due to the recovery circuit corresponds to an increase in the input capacitance of the charge amplifier of 2 pF. Author (NSA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N70-18437*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
A STABILITY BOUND FOR RELAY CONTROL SYSTEMS IN NON-PHASE VARIABLE FORM
B. F. Goldstein and D. P. Lindorff Nov. 1969 22 p refs
(Grant NGL-07-002-002)
(NASA-CR-107929) Avail: CFSTI CSCL 09C

An approach for determining a stability bound is considered in which the system is assumed to be subject to unknown but bounded parameter variations. The approach assumes that a bound, inside which all trajectories will be stable, can be found if a similarity transformation is used for each parameter set within the parameter space. Each resultant bound determined in the phase-variable space is then mapped into the original space where some measure of a bound on stable performance may be obtained. The mapping is accomplished by the use of Lyapunov contours. The technique was applied to a plant consisting of a cart supporting an inverted pendulum. It was found that in order to reduce the plant parameter space, the resulting mathematical manipulation became quite cumbersome. A comparison was made of the bound determined by this method with a recoverable set obtained in previous research. It was concluded that the present stability bound results in a very conservative estimate of the recoverable initial conditions. D.L.G.

N70-18505*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
REALISTIC ERROR BOUNDS FOR A REDUCED-STATE MODEL-REFERENCE CONTROLLER
T. M. Taylor Oct. 1969 21 p refs
(Grant NGL-07-002-002)
(NASA-CR-107930) Avail: CFSTI CSCL 09C

The problem of controlling a plant which is imperfectly identified is investigated with an aim of developing a control which guarantees stability over the range of parameter uncertainty involved. The design of model reference Liapunov controllers is extended to the case wherein a linear filter is incorporated in the

implementation of the switching function. The design permits filtered measurements of available states and filtered approximation of inaccessible states. It also facilitates the evaluation of the effects of transducer dynamics. By use of the proposed design, Lagrange stability was obtained. The bound estimation and trade-off effects of filtered noise and filter error are discussed. Factors affecting the bound are evaluated in terms of their contribution to the width of the region of imperfect control. D.L.G.

N70-18911*# Texas Univ., Austin. Electrical Engineering Research Lab.
THE USE OF GAUSSIAN FUNCTIONS IN RADIO ASTRONOMY SOURCE MEASUREMENTS
J. R. Cogdell 31 May 1969 51 p
(Grant NGL-44-012-006)
(NASA-CR-108144; NGL-006-69-2) Avail: CFSTI CSCL 09C

The utilization of Gaussian assumption in the analyses of radio source observations is discussed. Statistical effects of pointing errors are used to describe antenna temperature as a statistical average; the receiver noise is introduced as a stochastic sampling process and the effects of filtering the receiver output are examined. Filter distortion effects are related to the source strength problem and corrections are given. G.G.

N70-18969 Wisconsin Univ., Madison.
PROCEDURES FOR THE ANALYSIS AND SYNTHESIS OF PULSE-WIDTH MODULATED CONTROL SYSTEMS
James Clyde Harris (Ph.D. Thesis) 1968 237 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-924

The purpose is threefold: (1) To evaluate the literature and formulate a unified theory on the analysis and synthesis of pulse-width modulated control systems. (2) To extend this body of theory by developing a procedure for stochastic analysis of the responses of multidimensional pulse-width modulated control systems resulting from nonstationary random disturbance inputs. (3) To extend this body of theory by developing a synthesis procedure for determining the choice of pulse widths and pulse polarities in a system, which minimizes the error index. It is considered that some of the components of the state vector x(t) are not measurable and that those variables which are measured contain Gaussian measurement noise of zero mean and known variance. Dissert. Abstr.

N70-18986*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN ANALYSIS AND PERFORMANCE OF A 2.5 kVA PULSE-WIDTH-MODULATED STATIC INVERTER
Francis Gourash and Arthur G. Birchenough Washington Feb. 1970 31 p refs
(NASA-TN-D-5586; E-5262) Avail: CFSTI CSCL 09A

The inverter is rated for an output of 2.5 kVA and uses parallel-connected power transistors with balancing reactors for equal current sharing and auxiliary circuits to provide fast switching and compensation for the finite switching times. The measured efficiency of the power stage is 86 percent with a unity-power-factor load of 1.5 kW, and 77.5 percent at the 2.5 kVA, 0.7 power factor, full-load rating. Total harmonic distortion of the sinusoidal output voltage is 6.5 percent. Author

N70-19005 National Lending Library for Science and Technology, Boston Spa (England).
EXPANSION OF THE THEORY OF FORMING CONTRAST IN p-n JUNCTION IMAGE IN ELECTRON MICROSCOPE
G. B. Spivak et al 20 Aug. 1969 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk USSR, Ser. Fiz. (Moscow), v. 32, no. 7, 1968 p 1124–1129
(NLL-PORS-Trans-2583-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

The formation of junction image is influenced by a number of parameters, such as accelerating field, voltage difference across the p-n junction, aperture width, and its position with respect to the image. Various contrast types can be obtained by varying these parameters. The relative contrast is calculated more accurately by numerical integration of the equations of motion and the maximum sensitivity of the receiver towards the variation of reverse bias applied to the p-n junction is evaluated. Author

N70-19021 Northwestern Univ., Evanston, Ill.
APPLICATIONS OF THE GENERALIZED MATRIX INVERSE IP NETWORK THEORY
Ronald Keith Manherz (Ph.D. Thesis) 1968 76 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-6961

Several relations among the directed graph incidence and circuit matrices and their generalized inverses are developed. In particular a theorem is presented which enables one to express either of the Kirchhoff's laws in terms of either the incidence or the circuit matrix. Explicit expressions are developed for a wide class of immittance matrices of multiport networks constructed on multipole networks characterized by an indefinite admittance matrix. Two analog methods are presented for computing the generalized inverse of an arbitrary complex matrix. One method employs ideal transformer networks and the other the electronic analog computer. The least squares mimimization property of the generalized inverse is employed to minimize a class of quadratic forms subject to linear constraints on the variables. These results are then employed to obtain explicit solutions to a class of quadratic error minimization problems in timg varying networks. Error minimization methods are also given for the steady state frequency domain. Dissert. Abstr.

N70-19177*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RADIATION FROM SLOTS ON CYLINDRICAL BODIES USING GEOMETRICAL THEORY OF DIFFRACTION AND CREEPING WAVE THEORY
Constantine A. Balanis Washington Feb. 1970 79 p refs
(NASA-TR-R-331; L-6604) Avail: CFSTI CSCL 09C

A hybrid solution employing wedge diffraction and creeping wave theories is used to compute the radiation patterns of axial and circumferential slots in the principal planes (equatorial and elevation) on conducting cylinders of finite and infinite lengths. The slots are excited by parallel-plate waveguides operating in the TEM and TE sub 10 modes. For the equatorial-plane pattern, the total field in the lit region is obtained by the superposition of two fields, that is, the wedge-diffracted and the creeping-wave fields. The wedge-diffracted field is obtained by approximating the parallel-plate-cylinder geometry with two wedges, each formed by a wall of the waveguide and a tangent plane to the cylinder surface at the edge point. The creeping-wave contribution is obtained by the use of diffraction and propagation coefficients of waves traveling around conducting curved surfaces. The total field in the shadow region is obtained solely from the creeping-wave contribution. For the elevation-plane pattern, wedge diffraction techniques for the entire pattern are employed. The main advantages of the present technique are that it can be applied to geometries where modal solutions are not possible, in numerical ranges where the convergence properties of modal expansions are relatively poor, in parametric design problems since the contribution from each field is separated, and in the analysis of antennas with finite physical sizes. Author

N70-19298 Newark Coll. of Engineering, N.J.
NOISE SPECTRAL DENSITY AS A DIAGNOSTIC TOOL FOR RELIABILITY OF p-n JUNCTIONS
Young Duck Kim (Ph.D. Thesis) 1968 254 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 68-16972

The feasibility of choosing noise-voltage spectral density as a prediction parameter for the degradation of p-n junctions has been examined both theoretically and through a series of life-tests. Experimental facts show that the noise-voltage spectral density, S sub v(W), observed in a p-n junction under the breakdown condition tends to be white and S sub v(W) is inversely proportional to the breakdown current. Furthermore, some p-n junctions display one or more multiple peaks of S sub v(W) at different current levels which cannot be explained by any of the existing noise theories. Life test experiments indicate that units whose S sub v(W) have multiple peaks are highly correlated with degradation of leakage characteristic over a life-test period. It is recommended that some unreliable units be eliminated by inspecting the multiple-peak phenomenon which indicates the existence of microplasmic breakdown channels in a p-n junction. Dissert. Abstr.

N70-19307 National Lending Library for Science and Technology, Boston Spa (England).

DESIGN OF MAGNETIC CIRCUITS WITH DISTRIBUTED PARAMETERS, POSSESSING AXIAL SYMMETRY AND A LARGE AIR GAP

B. V. Frolov Sep. 1969 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Elektromekhan. (Novocherkassk), no. 7, 1968 p 711–717

(NLL-RTS-5295) Avail: Natl. Lending Library, Boston Spa, Engl.: 17s 6d or 2 NLL photocopy coupons

Mathematical expressions are developed for determining the basic values characterizing the magnetic field in the various parts of the magnetic circuit. The circuit considered consists of a hollow thick-walled steel cylinder with a steel bar coaxially inside. The radial magnetic field between the cylinder and bar is created by disk coils, and the magnetic breaker system is also discussed. Formulas are given for magnetic field intensity, number of coils, and physical dimensions. N.E.N.

N70-19314*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

AUTOMATED FAULT DIAGNOSTICS FOR FREQUENCY DEPENDENT CIRCUITS BY CORRELATION AND VARIANCE TECHNIQUES

Henry B. Metcalf Washington Feb. 1970 23 p refs

(NASA-TR-R-328; C-95) Avail: CFSTI CSCL 09C

A computer program has been adapted to perform fault diagnosis in frequency-dependent systems. The program simulates a short circuit and an open circuit for each network parameter and prints out a modified transfer function of the network corresponding to each simulated failure. Experimental and simulated data are subjected to correlation and variance analysis in order to rank all parameters according to probability of failure in the network model. The program lists, at present, single failures in order to decreasing probability. Possible extensions of the program to multiple failures are examined. Author

N70-19454*# Institute of Nuclear Research, Warsaw (Poland).

PROCESS OF CHARGE COLLECTION IN SILICON DRIFTED DETECTORS WITH UNHOMOGENEOUS DISTRIBUTION OF ELECTRIC FIELD

Marek Moszynski 1968 130 p refs In POLISH

(INR-972) Avail: CFSTI

On the basis of the investigation of the time spread and the shape of pulses from silicon drifted detectors it has been found that the distribution of the electric field in the detector is represented by a second order polynomial. An analysis of the charge collection process based on the postulated electric distribution has been carried out. The resulting theoretical pulse shape is in good agreement with the experimental one. The calculated and experimentally determined time spreads are of the same order of magnitude, while the earlier theory of charge collection in the detector with the uniform electric field predicts 40 times lower time spreads. Author (NSA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N70-18407*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CONTROL TECHNIQUES FOR SIMULTANEOUS THREE-DEGREE-OF-FREEDOM HYDRAULIC VIBRATION SYSTEM

H. D. Cyphers and J. F. Sutton *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 23-33 (See N70-18404 07-32)

Avail: CFSTI CSCL 14B

A new combined environment test facility known as the Launch Phase Simulator is now in operation. Included in the facility is a vibration system designed to simulate the low frequency mechanical vibrations experienced by the spacecraft during the launch phase of flight. The system is capable of operation both on the end of a large centrifuge arm and as a conventional shaker system mounted on a fixed reaction mass. The operation and control of the vibration system, problems relating to phase and amplitude control of the shakers for sinusoidal and random inputs, and several advanced control techniques studied. The vibration system consists of five electrohydraulic actuators mounted in a configuration which permits three degrees of freedom, corresponding to a combination of longitudinal, yaw, and lateral vibration. The circuit may aid in the detection of the galling phenomenon which plagues shaker designers and users. Author

N70-18527*# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).

THE LONGSHOT FREE-PISTON CYCLE. PART 1. THEORY

Kurt R. Enkenhus and Claudio Parazzoli Nov. 1968 76 p refs

(AD-697170; VKI-TN-51) Avail: CFSTI CSCL 14/2

An approximate analytical solution is presented for the free-piston cycle in the VKI Longshot Hypersonic Tunnel. The Longshot differs from a conventional gun tunnel in that a heavy piston is used to compress the nitrogen test gas, which is then trapped at the end of the barrel at very high pressure by the closing of a system of check valves as the piston rebounds. Real gas effects are accounted for by assuming that the nitrogen behaves as a Van der Waals gas with variable specific heats. Author (TAB)

N70-18575*# Naval Ordnance Lab., White Oak, Md.

CAPABILITY OF NOL BALLISTICS RANGES FOR OBTAINING SPHERE DRAG COEFFICIENT DATA

W. Carson Lyons, Jr. *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 69-82 refs (See N70-18570 07-01)

Avail: CFSTI CSCL 14B

Descriptions of three ballistics range facilities are presented. The Mach number-Reynolds number capability for each facility is shown for the case of obtaining drag coefficients of spheres. It is shown that these three facilities can cover most of the Mach number-Reynolds number field between Mach numbers of 0.1 and 22 and between Reynolds numbers of 10 to the 1st power and 10 to the 7th power. A discussion of various sources of errors involved in measuring sphere drag coefficients in a ballistics range and of estimates of the magnitude of the errors is presented. Author

N70-18654*# Toronto Univ. (Ontario).
IMPOSITION-DRIVEN SHOCK TUBE
I. I. Glass and J. C. Poinssot [1969] 16 p refs
(Grant NGR-52-026-023)
(NASA-CR-106095) Avail: CFSTI CSCL 14B

Stoichiometric mixtures of hydrogen-oxygen at 200, 400, and 600 psi initial were detonated at the geometric centre of an 8 in dia hemispherical chamber by a very short exploding wire. The detonation wave in the mixture moves out towards the periphery where it can strike a shell of PETN explosive to produce an explosive driven implosion or it may be allowed to reflect from the steel surface only, without an explosive liner, as an implosion wave moving into a highly preheated gas. As expected, for the gas runs only, the shock strength increases nonlinearly with initial pressure. For 600 psi initial, a shock Mach number, M sub s = 40, was obtained in a 8 mm dia channel filled with air at 1 torr. The shock decayed to M sub s = 11, over about 180 cm. Blast wave decay, and viscous and ablative losses undoubtedly cause the high attenuation. A numerical analysis predicts shock Mach numbers M sub s at approximately 100, using a modest loading of 200 g PETN and 200 psi 2H2+02. The small barrel bore was used to check out the limiting case when the facility is used as a missiles-projectile hypervelocity launcher or shock tube. Explosive runs will be made in 8 mm and 25 mm dia channels, using the 8 in dia driver chamber, in the near future. Author

N70-18701*# Philco-Ford Corp., Houston, Tex. Electronics Group.
MISSION CONTROL CENTER Quarterly Progress Report, 1 Oct.–31 Dec. 1969
10 Jan. 1970 118 p refs
(Contract NAS9-1261)
(NASA-CR-102166; PHO-TR-470) Avail: CFSTI CSCL 22D

A full schedule of Mission H-1 validation tests, simulations and pad tests was successfully supported during the first half of the quarter prior to launch on 15 November. Emphasis was placed on MCC intersystem data flow training, contingency planning and simulated equipment problems for personnel and instrumentation operators, to improve trouble isolation and system restoration responses should an intersystem problem develop during the Apollo 12 flight. Standby MCC engineering support was also available in the event of an emergency. During the 10 days of mission support, MCC systems performed at their highest level of effectiveness. There were no losses of critical data nor interruptions to critical communications due to MCC failures. Documentation of the MCC configuration for Mission H-2 was issued. Reconfiguration and associated testing were completed on 16 December. Author

N70-18766*# General Electric Co., Cincinnati, Ohio.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, Period Ending 15 Oct. 1969
R. W. Harrison 23 Oct. 1969 66 p refs
(Contract NAS3-6474)
(NASA-CR-72620; GESP-376; QPR-18) Avail: CFSTI CSCL 14B

The Rankine corrosion test loop had successfully completed 6000 hours of operation. The loop was put on automatic control and constant surveillance was terminated. Post-test evaluation of the lithium thermal convection capsules revealed corrosion in ASTAR 811C specimens which had been welded and not postweld annealed. Fabrication of the 1900 F lithium loop is nearing completion. All subassemblies have been joined. Author

N70-18797*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TRACTION DRIVE SYSTEM DESIGN CONSIDERATIONS FOR A LUNAR ROVING VEHICLE
Clyde S. Jones, Jr., Billy J. Doran, and Frank J. Nola 25 Nov. 1969 42 p
(NASA-TM-X-53972) Avail: CFSTI CSCL 13F

For an optimum design, the weight, energy consumption, and operational flexibility of the traction drive system for a lunar roving vehicle are considered along with the power supply, motor, and power train. Other problems considered in this paper include: environment and motor dissipation, motor type (i.e., ac or dc) and commutation if dc, motor controller (i.e., switching of large currents), delivery of torque at varying speeds, power train, use of regenerative braking and conservation of energy, and power supply voltage variation. These problems are studied in view of certain general system specifications, which fall into weight, performance, and environment categories. Tradeoff studies are considered for optimization in each of these areas. Special consideration is given to the controller and system design as it pertains to regenerative braking and the conservation of energy. Some aspects of changing the modes of motor operation to satisfy extreme performance requirements of speed and torque are discussed. Author

N70-18801*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FLIGHT CONTROL OF THE APOLLO LUNAR LANDING MISSION
M. P. Frank Dec. 1969 28 p Presented at the 8th Intern. Symp. on Space Tech. and Sci., Tokyo, 25 Aug. 1969
(NASA-TM-X-58036) Avail: CFSTI CSCL 22A

The purpose of the paper is to provide the reader with insight into the functions and activities carried out in the Mission Control Center and into the procedures used for controlling the Apollo lunar-landing mission. To provide the proper background, the first part of the paper consists of a functional description of the worldwide tracking and data acquisition network, of the Mission Control Center, and of their capabilities in providing the necessary data from the spacecraft and flight crew to the flight control team in the Mission Control Center. The flight control organization and the technical disciplines involved are discussed. A detailed description of the flight control activities and of the data and information transferred between the flight crew and the ground controllers is given for particular phases of the mission. Emphasis is placed on the navigation and guidance aspects, but the systems-monitoring and consumables analysis activities are also discussed. Author

N70-19053# General Electric Co., Philadelphia, Pa.
COMPARISON OF CALCULATED AND MEASURED LIGHTNING EFFECTS ON SPACE VEHICLE LAUNCH COMPLEXES
E. R. Uhlig *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 400–419 (See N70-19027 07-02)
Avail: CFSTI

Problems encountered on NASA's launch complexes 34, 37, and 39 are summarized, and indirect and direct lightning effects control is outlined. Current amplitudes were measured using magnetic links. Minor electrical damage was observed, as well as lightning strokes on mobile launchers. J.A.M.

N70-19055# Weather Squadron (24th), Kelly AFB, Tex.
STATIC ELECTRICITY IN AIR FORCE REFUELING SYSTEMS
J. B. Goodwin, Jr. *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 442–452 (See N70-19027 07-02)
Avail: CFSTI

Static grounds and flexible cables with battery clips used to maintain electrical continuity are discussed. The main deficiencies of grounding were: (1) When fragile battery clips were broken, it caused extensive damage. (2) Aircraft paint acted as an insulator between hardware and the airframe and prevented electrical continuity. (3) Adequate grounding points were lacking on assigned aircraft. (4) Aircraft are parked with overlapping wings. (5) The number, location, and method of attachment of grounding receptacles needs standardization on all aircraft. Results of a program to establish aircraft grounding standards are given. Refueling and

defueling procedures with static charge protection are recommended, along with increased refueling rates and improved handling systems for air bus and supersonic aircraft. J.A.M.

N70-19084# California Univ., Berkeley. Lawrence Radiation Lab.
ERA DEVELOPMENT AT BERKELEY
Denis Keefe 26 Sep. 1969 21 p refs Presented at the 7th Intern. Conf. on High Energy Accelerators, Moscow
(Contract W-7405-ENG-48)
(UCRL-18896; CONF-690811-11) Avail: CFSTI

Progress on the development of an electron-ring accelerator at Berkeley is described. Design parameters are discussed, and results of experiments with Compressor III using the Astron linear induction electron accelerator are presented. Ring formation, compression, extraction, and acceleration are considered. NSA

N70-19212# Argonne National Lab., Ill.
GLOVEBOX FACILITY FOR PYROCHEMICAL RESEARCH AND DEVELOPMENT WORK WITH Pu 238
J. Fischer May 1969 42 p refs
(Contract W-31-109-ENG-38)
(ANL-7568) Avail: CFSTI

A detailed description of a facility for conducting pyrochemical research and development work with plutonium-238 is given. The facility is comprised of a negative-pressure glovebox containing both a high-purity helium and an air-atmosphere section for experimental work, and an air-atmosphere glovebox for analytical work. The general capabilities of the facility are discussed, and the gloveboxes and associated equipment are described in detail. Equipment items include furnaces, gloves, utilities, cooling-water and vacuum systems, and instrumentation for temperature measurement and for atmosphere purification and control. Author (NSA)

N70-19416# Douglas United Nuclear, Inc., Richland, Wash.
DESCRIPTION AND USES OF A CRITICAL SYSTEMS DATA FILE FOR NUCLEAR PLANTS
G. E. Gregor, D. A. Snyder, and P. D. Gross 1 Oct. 1969 24 p refs
(Contract AT(45-1)-1857)
(DUN-SA-124) Avail: CFSTI

A Critical Systems Data File is described which was developed as an integral part of an overall maintenance program for a research installation. The Data File provides computerized recording, auditing and retrieval of test and inspection data to facilitate maintaining and improving the reliability of equipment vital to the operation of nuclear plants. Author (NSA)

N70-19618# TRI-Univ. Meson Facility, Vancouver (British Columbia).
MAGNETIC FIELD TOLERANCES FOR A SIX-SECTOR 500 MeV H(-) CYCLOTRON
M. K. Craddock and J. Reginald Richardson Dec. 1968 43 p refs
(TRI-67-2) Avail: CFSTI

The tolerances which beam dynamical requirements place on the accuracy to which the cyclotron magnet must be constructed and its magnetic field measured are discussed. The tolerance most significantly affecting manufacturing methods is probably that demanded of the spiral shape of the sectors to keep vertical focusing within acceptable limits. At large radii the precision required reaches + or - 0.033 C and will necessitate a shimming program subsequent to manufacture. Isochronism sufficient to give 36% microscopic duty factor can be provided by a radial field gradient correct to + or - 2 G/ft together with 35 circular trim coils. Separated turn acceleration would require + or - G/ft with 54 trim coils and very closely controlled dee voltage, radio frequency and magnet excitation. Author (NSA)

N70-19659# Princeton Univ., N.J. Palmer Physical Lab.
DESIGN FEATURES OF THE PRINCETON AVF CYCLOTRON FACILITY
R. E. Pollock Sep. 1969 7 p Sponsored by AEC
(PUC-937-371) Avail: CFSTI

Operating performance is reported and several features in the design of the accelerator, beam line and laboratory of the Princeton A. V. F. Cyclotron are described. Although construction began of a close copy of the 56 MeV cyclotron at Michigan State University, there were a number of modifications to the machine, and a somewhat different approach to the laboratory layout and beam transport design was adopted. An rf amplifier, outside the vault shielding, drives the dees through tunable half wave transmission lines. Mode separation is obtained with a simple transmission line coupler. The tuning range was extended by a modification of the dee stem inductance. A magnetic channel in the beam extraction system uses coils and laminated iron foil stacks which avoid saturation while reducing the power demand relative to an air core design. Author (NSA)

N70-19660# Brookhaven National Lab., Upton, N.Y. Accelerator Dept.
A BRIGHT HIGH-GRADIENT 750-keV- ION GUN
Th. J. M. Sluyters, R. Amari, V. Korvaik, R. Lockey, and S. Senator 15 Oct. 1969 55 p refs
(BNL-14138) Avail: CFSTI

A one meter long, air insulated, Pierce electrostatic accelerator of 750 keV is described in detail. It has an accelerating length of only 17 cm and there is no prefocusing lens. Optically clean pulsed beams of 200 mA have been obtained, using a duoplasmatron with expanded plasma cup. The accelerator has been in continuous operation as preinjector for the Brookhaven Alternating-Gradient Synchrotron since October 1968. Author (NSA)

N70-19661# Cambridge Electron Accelerator, Mass.
CAMBRIDGE ELECTRON ACCELERATOR Semiannual Report, 1 Jan.-30 Jun. 1969
K. Strauch and W. A. Shurcliff 29 Jul. 1969 47 p refs
(Contract AT(30-1)-2076)
(CEAL-1049) Avail: CFSTI

The total delivered accelerator prime-user hours and parasite-user hours was 3630. Delivered prime-time hours was 2498 compared to 1546 in the previous six-month period. The highest intensity (10 to 20 mA) long term (8-day) 6-GeV run to date was achieved. The 20 experiments underway or in preparation are described, as well as progress on the colliding beam facility. For the first time a constant energy electron beam was switched from the ring into the bypass, and a 1/e time constant of 25 seconds was achieved for such a beam. A better understanding of beam cross sections, chromaticity, momentum vector, and beta function is being attained, and it is apparent that longer time constants will soon be possible. The 130-MeV positron linac has been received, and installation of parts is nearly complete. The on-line detector is progressing well. Satisfactory progress was made on the optical detector and magnetic detector also. Author (NSA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N70-18319# Space Sciences, Inc., Waltham, Mass.
DRAG OF A SLENDER CONE IN HYPERSONIC FLOW
Harold Grad and Pung Nien Hu 1969 15 p refs Sponsored in part by ARPA

(Contracts N00014-68-C-0130; AF 49(638)-1666; Grant AF-AFOSR-815-67)
(AD-696396; AFOSR-69-2722TR) Avail: CFSTI CSCL 20/4

Consideration is given to hypersonic flow past a slender cone which is diffusely reflecting and cool. An exact expression is obtained for the drag using the nonlinear Boltzmann equation for hard spheres in the limit in which the three parameters - Mach number, Knudsen number, and reciprocal cone angle - all approach infinity with arbitrary but bounded ratios. Author (TAB)

N70-18326# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
STABILITY THEORY FOR A PAIR OF TRAILING VORTICES
S. C. Crow Sep. 1969 42 p refs
(D1-82-0918) Avail: CFSTI

Trailing vortices do not decay by simple diffusion. Usually they undergo a symmetric and nearly sinusoidal instability, until eventually they join at intervals to form a train of vortex rings. The present theory accounts for the instability during the early stages of its growth. The vortices are idealized as interacting lines; their core diameters are taken into account by a cut off in the line integral representing self-induction. The equation relating induced velocity to vortex displacement gives rise to an eigenvalue problem for the growth rate of sinusoidal perturbations. Stability is found to depend on the products of vortex separation b and cut off distance d times the perturbation wave number. Depending on those products, both symmetric and antisymmetric eigenmodes can be unstable, but only the symmetric mode involves strongly interacting long waves. An argument is presented that $d/b = 0.07$ for the vortices trailing from an elliptically loaded wing. The vortex displacements are symmetric and are confined to fixed planes inclined at 48 deg to the horizontal. Author

N70-18359# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
TRANSONIC FLOW PAST THIN BODIES [L'ECOULEMENT TRANSSONIQUE AUTOUR DES CORPS ELANCES]
Yu. B. Lifshits [1969] 15 p refs In FRENCH and RUSSIAN Transl. into FRENCH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), no. 4, 1968 p 129–133
(LRBA-69-1131) Avail: CFSTI

Using the method of asymptotic expansions, the flow past thin, three-dimensional bodies in a gas flow is constructed as a second approximation. The maximum thickness ratio is taken as the small parameter. A similar problem for supersonic and subsonic flows was solved by constructing linear equations which describe flow at some distance from the body, and its propagation toward the axis. When the incident flow is transonic, the given method permits solution of the problem over the entire range of speeds, the area rule being obtained automatically as both a first and second approximation. Another result is the possibility of calculating the magnitude of aerodynamic loading from the known pressure distribution on an equivalent body of revolution. Transl. by R.B.

N70-18361# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GRIDS FOR TRANSONIC AND SUPERSONIC FLOW VELOCITIES
N. M. Markov 24 Apr. 1969 16 p ref Transl. into ENGLISH from Teoriya i Rashet Lopatochnogo App. Osevykh Turbomashin, (Moscow), 1966 p 174-184
(AD-696543; FTD-HT-23-1286-68) Avail: CFSTI CSCL 21/5

The basic problems of steam and gas turbine blade theory are presented. Methods of calculating the aerodynamic characteristics of limited and unlimited blade-length cascades are given, along with the theoretical basis for selecting the permissible roughness of a blade surface. The effect of surface roughness on energy losses in cascades was also covered. The characteristics of the working mediums flow in the cascades at supersonic speeds are dealt with, and a theory for calculating relatively-long turbine blades is presented. The book is intended for scientific-engineering personnel dealing with the problems of investigation, construction, and testing of turbomachines. It can also be used by advanced students specializing in power engineering. Author (TAB)

N70-18385# National Aeronautical Lab., Bangalore (India).
SKIN FRICTION AND LAMINAR-SUBLAYER THICKNESS IN COMPRESSIBLE TURBULENT BOUNDARY LAYERS
K. Sheshagiri Hebbar and P. A. Paranjpe Jun. 1969 32 p refs Submitted for publication
(NAL-TN-14) Avail: CFSTI

Based on reference temperature technique for compressible flows and empirical laws of resistance for incompressible turbulent flows over smooth flat plates, simple, explicit and analytical expressions for the ratios of local skin-friction coefficient, average skin-friction coefficient and laminar sublayer thickness in compressible turbulent boundary layers on smooth surfaces to the corresponding values in incompressible case for the same free stream conditions are derived as functions of Mach number, Reynolds number, Prandtl number and wall-to-free-stream temperature ratio. The expressions for the ratios of skin-friction coefficients compare very well with available experimental data including those at very high Reynolds number and those with heat transfer. The analysis brings out the appreciable effect of compressibility and heat transfer on skin-friction coefficient and laminar-sublayer thickness and therefore on maximum permissible roughness in compressible turbulent flows. High speed flows permit considerable increase in the permissible roughness whereas cooling of the surface decreases it. For the usual value of isentropic exponent equal to 1.4, the numerical results are presented in the form of graphs to bring out quantitatively the appreciable effect of compressibility and heat transfer and for the convenience of users. An approximate estimate of the laminar sublayer thickness based on local fluid properties is appended. Author

N70-18390*# Minnesota Univ., Minneapolis. Dept. of Mechanical Engineering.
FILM COOLING FOLLOWING INJECTION THROUGH INCLINED CIRCULAR TUBES
R. J. Goldstein, E. R. G. Eckert, V. L. Eriksen, and J. W. Ramsey Nov. 1969 55 p refs
(Contract NAS3-7904)
(NASA-CR-72612; HTL-TR-91) Avail: CFSTI CSCL 20D

Film cooling effectiveness measurements with injection of air through discrete holes into a turbulent boundary layer of air on a flat plate are described. The secondary air is injected through either a single hole or a row of holes spaced at three diameter intervals across the span with an injection angle of 35 degrees to the flow and in a different series of tests through a single hole with lateral injection angles of either 15 or 35 deg. Results are compared with earlier tests to show that the film cooling effectiveness increases as the boundary layer thickness at the injection location is decreased. Data from single hole tests are similar to that for a row of holes at low blowing rates, but significant differences are observed at higher blowing rates. The effect of lateral injection is to provide cooling over a wider area than when injection is normal to the flow or inclined downstream only. Author

N70-18429# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
COMMUNICATION BETWEEN BASE AND LEEWARD REGION OF A CONE AT ANGLE OF ATTACK IN A HYPERSONIC FLOW Final Report
Kenneth F. Stetson and Eric G. Friberg Jul. 1969 37 p refs
(AD-696584; ARL-69-0115) Avail: CFSTI CSCL 16/3

The results of a wind tunnel investigation of separated flow over a 5.6 degree half-angle cone at angle of attack are presented. Surface pressure and oil flow data were obtained at a free stream Mach number of 14.2 and a free stream Reynolds

number per foot of 650,000. It was observed that separated flow on the cone at angle of attack occurred while the cone leeward pressures were significantly larger than the base pressure. This large pressure difference indicated there was no subsonic communication between base and leeward region. The separated flow field for this case was then analogous to that of an infinitely long cone. At angles of attack greater than that which was required to equalize base and leeward pressures a new flow feature was observed. The cone leeward flow expanded to pressure levels below base pressure. A secondary separation occurred on the rear portion of the cone leeward surface, which appeared to contain subsonic reverse flow. In the neighborhood of this secondary separation, the leeward surface pressures increased and the separation line moved further away from the leeward meridian. Author (TAB)

N70-18443# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHARACTERISTICS OF THE CENTRIFUGAL AIR-PRESSURE NOZZLE

E. D. Novikov 23 Sep. 1969 12 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Inst. Morsk. Flota. Inform. Sb., (USSR), no. 53, 1967 p 50-60

(AD-696328; FTD-HT-23-256-69) Avail: CFSTI CSCL 20/4

The principle features of atomizing nozzles are: fineness of spray, determined as a function of the mean or maximum droplet diameter; size distribution of droplets in flame; distribution of the characteristic mean or maximum droplet diameters over the flame cross section; flame spraying density q, kg/m(superscript 2)-sec, and the hydraulic drag of the nozzle, characterizing the effectiveness of a given nozzle design. A test rig for the experimental determination of these characteristics was developed. This rig was used to investigate the flare angle of flame and the spraying density for an air-pressure nozzle on varying the parameters within given ranges. The flare angle of flame was measured according to photographs, while spraying density was measured by trapping spray particles in test tubes positioned along the diametral cross section of the flame. The distribution of mean surface droplet diameter over the flame cross section was determined by trapping droplets on glass slides coated with a mixture of vaseline and transformer oil. It was established that neither the temperature of the atomized air nor the surface tension of the liquid affect markedly the flare angle of flame and the density of spraying. Author (TAB)

N70-18482# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

AN APPROXIMATE METHOD FOR CALCULATING THE PARAMETERS OF A SUPERSONIC GAS FLOW IMPINGING ON AN INCLINED PLANE BARRIER [METHODE DE CALCUL APPROCHE D'UN JET DE GAZ SUPERSONIQUE FRAPPANT UN OBSTACLE PLAN INCLINE]

Yu. M. Rudov and V. N. Uskov [1969] 14 p refs *In* FRENCH and RUSSIAN

(LRBA-69-0520) Avail: CFSTI

A gas flow from a jet engine nozzle has parameters of Mach number, pressure, density, time and an incalculability factor and impinges on a plane barrier at a certain distance from the shear plane of the nozzle. It is necessary to find the parameters of the gas in the region adjacent to the barrier, which, due to formation of compression and negative pressure waves and their reflection from the barrier and the free surface, are divided into a number of zones with different parameters. The wave structure of the flow is analyzed in the section from the shear plane of the nozzle to the barrier and in the zone of interaction with it. Examples are given for calculating the gas parameters, the wave structure of the flow and the variation in gas parameters in the section from the nozzle to the barrier being excluded for simplicity. Transl. by R.B.

N70-18518# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Fluid Dynamics Facilities Research Lab.

SURFACE CONDITIONS IN THE LEEWARD REGION OF A BLUNT CONE AT ANGLE OF ATTACK IN HYPERSONIC FLOW

Kenneth F. Stetson and Eric G. Friberg Jul. 1969 12 p refs (Contracts AF 33(615)-67-C-1758; AF 33(615)-2175)

(AD-696583; ARL-69-0114) Avail: CFSTI CSCL 16/3

The results of a wind tunnel investigation of separated flow over a blunt cone at angle of attack are presented. Surface pressure and oil flow data were obtained at a free stream Mach number of 14.2 and a free stream Reynolds number per foot of 650,000. A three-dimensional separation model for hypersonic flow over a blunt cone at angle of attack is proposed. The leeward side of the cone contains an initial region of attached, converging flow followed by a divergence into the separated region. The separated region does not originate from a singular point on the leeward meridian. In place of the expected singular point was a neck through which fluid passed from the upstream attached flow region into the separated region. Symmetrical separation lines developed downstream of the neck as the surface streamlines diverged. There was no evidence of reverse flow or subsonic communication with the base region. The separated region was considered to have the characteristics of symmetrical supersonic helical vortices. Author (TAB)

N70-18522# General Electric Co., Philadelphia, Pa. Space Div.

SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR VISCOUS SUPERSONIC FLOWS ADJACENT TO ISOTHERMAL AND ADIABATIC SURFACES Final Report, 1 Jun. 1968-31 May 1969

S. M. Scala and P. Gordon 28 Apr. 1969 84 p refs Presented at the Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow, Wright-Patterson AFB, Ohio, 7-8 May 1969

(Contract N00014-68-C-0404)

(AD-696175; GE-69SD1001) Avail: CFSTI CSCL 20/4

Since it is very desirable to have a computational procedure for the numerical calculation of high speed viscous flow fields, which does not require patchwork or fitting procedures for matching the strongly viscous regions generally found near surfaces to the weakly viscous outer regions, the authors have been developing a method for the calculation of complete flow fields which is based on the numerical solution of the complete time-dependent Navier-Stokes equations. In this paper, details of the procedure are presented for a number of geometries, including one-dimensional (the piston problem), two-dimensional (flow around a circular cylinder) and axially-symmetric (flow around an isothermal sphere) cases. The gas was treated as a perfect, diatomic, nondissociating, viscous, thermally conducting gas. At the surface in contact with the fluid, the two limiting boundary conditions for surface temperature are utilized, i.e., the low temperature limit corresponding to an isothermal wall (high heat transfer rate) and the high temperature limit corresponding to the adiabatic wall (zero heat transfer rate). The time-dependent structure of the flow field, including the velocity profiles, the density, temperature and pressure distributions is presented for each of the aforementioned geometries for a range of Reynolds numbers. Author (TAB)

N70-18535*# Oakland Univ., Rochester, Mich. School of Engineering.

CALCULATION OF THE DIELECTRIC CONSTANT OF A SUSPENSION OF SYMMETRIC ELLIPSOIDS IN A SIMPLE SHEAR FLOW

R. H. Edgerton *In its* Biosystems Eng. Res. 30 Oct. 1969 12 p refs (See N70-18528 07-05)

Avail: CFSTI CSCL 20D

Calculated is the dielectric constant of a suspension of symmetrical ellipsoids in a simple shear flow. If steady state is assumed, then in rotational diffusion the probability density functions

for distribution in terms of angles are inversely proportional to the angular velocity of the particles. Shear flow calculations of the dielectric constant require the knowledge of the distribution probabilities which can be determined by the relation between the angles or orientation and the orbital constant for a particle. G.G.

N70-18557# Polytechnic Inst. of Brooklyn, N.Y.
RESEARCH OF AERODYNAMIC PHYSICS INSTITUTE FOR PROJECT STRATEGIC TECHNOLOGY Semiannual Technical Summary Report, Period Ending 31 Aug. 1969
Martin H. Bloom Sep. 1969 23 p refs
(Contract Nonr-839(38); ARPA Order 529)
(AD-697313; PIBMRI-R-1295-9-69) Avail: CFSTI CSCL 20/4

The Polytechnic Institute of Brooklyn is conducting a broad interdisciplinary theoretical and experimental research program in aerodynamics and related physics pertinent to plasmas, diagnostics, electromagnetic scattering and turbulence, applicable to the current and long-range interests of the ARPA Strategic Technology Office. Emphasis is placed on subjects characteristic of ballistic missile defense situations. This report contains a compilation of abstracts of papers which were either accepted for publication or were published during the report period. The papers are on the subjects of Fluid Dynamics, Electromagnetics and Plasmas. The summary also contains a listing of papers submitted to journals, lectures, internal reports and staff activities. Author (TAB)

N70-18589# Minnesota Univ., Minneapolis. Saint Anthony Falls Hydraulic Lab.
THE INFLUENCE OF GAS NUCLEI SIZE DISTRIBUTION ON TRANSIENT CAVITATION NEAR INCEPTION
Frank R. Schiebe May 1969 65 p refs
(Contract Nonr-710(67))
(AD-697308; Rept-107) Avail: CFSTI CSCL 20/4

The report concerns research on the problem of transient cavitation on hydrodynamic bodies near inception conditions. A probabilistic model of the process is presented. The experimental apparatus for providing the bubble size distribution, which is a necessary input to the probabilistic model, is described. An acoustic cavitation occurrence counting system that can be used to check on the output of the probabilistic model is also described. Experiments conducted on a half body in a 6-inch water tunnel test system achieved fair agreement between the predictions of the probabilistic model and the measurements by the occurrence counting technique in some cases. Author (TAB)

N70-18687*# Wisconsin Univ., Madison.
RHEOLOGY
R. B. Bird *In* NASA. Marshall Space Flight Center Proc. of the Third Southeastern Seminar on Thermal Sci. 8 May 1968 p 3–54 refs Sponsored in part by NSF (See N70-18686 07-33)
(Grants NSF GP-1875; NSF G-11996) Avail: CFSTI CSCL 20D

The following mechanical experiments are analyzed in order to elucidate polymeric dynamic behavior: (1) a steady laminar tube flow with shear stress; (2) the surface shape of a liquid contained in the annular space between two cylinders, of which the inner is rotating; and (3) the transient response of a fluid in a cup, in the middle of which a cylindrical bob is suspended by torsion wire. Fluid behavior models formed for each experiment are based on constants obtained from viscosity curves, various dynamical responses, and molecular theory considerations to minimize the number of constants needed. The kind of rheological models that are to be used in any given problem depend on the various properties that have to be related, the viscosity data of the fluid, and the complexity of the flow configuration. G.G.

N70-18689*# North Carolina State Univ., Raleigh.
SOME ASPECTS OF AERODYNAMIC HEATING
R. W. Truitt *In* NASA. Marshall Space Flight Center Proc. of the Third Southeastern Seminar on Thermal Sci. 8 May 1968 p 73–142 refs (See N70-18686 07-33)
Avail: CFSTI CSCL 20M

Reviewed are the factors involved in the calculation of aerodynamic heating over a blunt nosed body at hypersonic speeds with emphasis on the local inviscid flow field. The non-equilibrium flow downstream of the normal portion of the bow shock is used to determine the conditions in the stagnation region and the classical equilibrium nozzle flow is summarized for a reacting gas. A more general analysis of equilibrium and frozen thermophysical properties is discussed in which both dissociation and ionization are considered. Boundary layer skin friction and aerodynamic heating effect on boundary-layer-shock-wave interactions are determined. G.G.

N70-18736# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD FOR ACCOUNTING FOR THE COMPRESSIBILITY OF AIR IN CALCULATING THE FLOW ELEMENTS OF PNEUMATIC INSTRUMENTS
O. B. Balakshin 8 Sep. 1969 16 p refs Transl. into ENGLISH from Gosudarstvennyi Nauchn-Issled. Inst. Mashinoved. (Moscow) 1967 p 204-213
(AD-696228; FTD-HT-23-1226-68) Avail: CFSTI CSCL 13/7

A new form of Bernoullis equation is proposed to account for the compressibility of a gas with any degree of accuracy in designing the flow elements of pneumatic devices. The compressibility is given in fractions of the velocity head expressed in terms of dimensionless compressibility ratios. The proposed form of the equation may also be used to account for hydraulic resistances in the flow elements and to determine the effect of compressibility and hydraulic drag on gas pressures and velocities. Both elements in which the flow undergoes sudden expansion and those in which the gas is suddenly constricted are considered. When the proposed form of Bernoullis equation is used, the effect of correcting for accuracy is always less than when the special form of the equation corresponding to zero input velocity of the flow is used. TAB

N70-18739*# United Aircraft Corp., East Hartford, Conn.
KINETIC FLOW PERFORMANCE IN NOZZLES Final Report
V. J. Sarli, L. S. Bender, L. D. Aceto, and W. G. Burwell 5 Dec. 1969 108 p refs
(Contract NAS3-11225)
(NASA-CR-72600; UARL-H910666-15) Avail: CFSTI CSCL 20D

Analytical investigations have been performed with the primary objectives of correlating experimental engine performance data for four space storable propellant combinations, CH4-Flox, CH4-OF2, B2H6-OF2 and B2H6-Flox; determining the deliverable performance of the tripropellant combination, H2-F2-Li; and assembling existing kinetic performance calculation procedures into a handbook for the propulsion engineer and vehicle designer to use. Summarized are correlations of analytically predicted and experimentally measured engine performance results for the four space storable propellant combinations and preliminary estimates of possible performance losses associated with two phase, nonequilibrium nozzle flow of the combustion products of the tripropellant combination, H2-F2-Li. Author

N70-18741*# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Fluid Mechanics Section.
GAS-SURFACE INTERACTION RESEARCH Final Report
Richard A. Oman and Vincent S. Callia Jun. 1969 53 p refs
(Contract NASw-1461)
(NASA-CR-108145; RE-365) Avail: CFSTI CSCL 20D

Results of research into several problems of gas-surface interaction are summarized. Numerical calculations using a large computer program were compared with laboratory experiments using a shock tube driven molecular beam apparatus, and remarkable quantitative agreement is evident for Ar/Ag(111) films at about 1 eV.

Some differences between theory and experiment for Ne/Ag(111) and in amplitude trends in Ar are indicated, and these differences offer the opportunity to remove some of the shortcomings of the interatomic potential models we are using. Theoretical results on the effects of surface roughness and related efforts providing simple analytical correlations for normal and tangential momentum exchanges are also described briefly. Complete details of these programs are described in separate reports. A description of the current status of theoretical work on associative desorption is given. Author

N70-18756*# Ling-Temco-Vought, Inc., Dallas, Tex. Research Center.
STUDY OF THE MECHANICS OF NON-NEWTONIAN FLUIDS Final Report, 26 Jun. 1963 – 26 Dec. 1968
C. S. Wells, Jr. and J. G. Spangler 3 Jan. 1969 34 p refs
(Contract NASw-729)
(NASA-CR-108141) Avail: CFSTI CSCL 20D

The investigations of three aspects of the mechanics of non-Newtonian fluids are described. They are: (1) correlation of data for turbulent flow of drag-reducing fluids and development of prediction techniques, (2) experimental studies of the effects of drag-reducing additives on the detailed characteristics of the turbulent shear layer, and (3) analyses of laminar boundary layer flow and transport properties of the fluids of interest. The most significant results include: considerable pressure drop and velocity profile data for solutions of several drag-reducing additives in turbulent pipe flow; a correlation of the data in terms of two easily-determined fluid properties, enabling skin friction to be predicted for arbitrary turbulent flows; observations that the significant effect of additives on turbulent shear characteristics is to thicken the viscous sublayer, increase the turbulence intensity in the turbulence production region near the wall, and affect the wall shear stress only when the additive is present in the wall region; observations that the effect of roughness in flows of drag-reducing fluids is consistent with the physical concept of a wall phenomenon and is predictable with a modified roughness function; heat transfer in drag-reducing fluids is predictable through the use of the Prandtl – Reynolds analogy; and the conclusion that all drag-reducing solutions tested showed evidence of supporting normal stresses, with no dependence on the age of the solution. Author

N70-18787*# National Aeronautics and Space Administration, Washington, D.C.
NEW CONTRIBUTION IN THE THEORY OF TURBULENT FLOWS
Frank Kamenetskiy Jan. 1970 4 p ref Transl. into ENGLISH from Novoe v Teorii Turbulentnykh Techenity, (Priroda), v. 10, 1969 p 74-75
(NASA-TT-F-12, 804) Avail: CFSTI CSCL 20D

A new contribution to turbulent flow theory is discussed. The approach includes the utilization of the principle of superposition of molecular and turbulent viscosity effects and involves a simplified method for the calculation of pulsation velocity. Author

N70-18808 University of Southern Calif, Los Angeles.
PROBLEMS IN TWO PHASE FLOW: THE RAYLEIGH AND STOKES PROBLEMS AND NONSTEADY CHANNEL FLOWS
James Valentine Healy (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9024

Several problems in two phase flow are solved. The Rayleigh problem of an incompressible viscous fluid flow with imbedded particles, over an infinite plate that is set into motion impulsively in its plane is studied. The velocities of the fluid and of the particles, and the wall shear stress, are obtained in integral form by operational methods. Asymptotic expansions for these quantities are found for large and small times, and for all times but small particle density. A digital computer study of the wall shear stress is carried out and, results are presented with the approximations. The agreement is extremely good. The Stokes problem of the same configuration, but with the imposition of an oscillating velocity at the plate, is solved by similar methods, and transient and steady periodic fluid and particle velocities are given. Dissert. Abstr.

N70-18823 Purdue Univ., Lafayette, Ind.
TWO PHASE FLOW IN VIBRATING DISCHARGE LINES
Roger William Griebe (Ph.D. Thesis) 1968 182 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-7451

An analytical and experimental investigation of two phase flow in a discharge line with a sharp edged entrance is presented for both vibratory and non-vibratory conditions. Classical one-dimensional fluid flow relations yielded analytical predictions which were closely matched by experimental data. An extensive experimental investigation showed that vibration of the test section generally caused an increase in pressure losses. A modified cavitation number was developed based on a free streamline analysis which considered the flow into the sharp-edged entrance as flow from an orifice. Good agreement with experimental data was shown to exist for several different geometric configurations. Furthermore, a time dependent cavitation number was developed for the cases where vibration was present. An analytical model describing choked two-phase flow was developed using the free streamline theory. Excellent agreement between theory and experimental data was achieved. Expressions associated with the normal shock separating the two-phase fluid and single phase fluid (liquid) were derived. In particular, equations defining the minimum pressure drop for choked flow and equations predicting the shock position as a function of the stagnation pressure loss are given. Good agreement between the analytical predictions and experimental data was obtained in both cases. Dissert. Abstr.

N70-18827*# Techtran Corp., Glen Burnie, Md.
CALCULATION OF THE SECONDARY FLOW IN TURBULENT FLUID FLOW [RASCHET VTORICHNOGO TECHENIYA V TURBULENTNOM POTOKE ZHIDKOSTI]
M. Kh. Ibragimov et al Washington NASA Jan. 1970 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 4, Jul. – Aug. 1969 p 168 – 170
(Contract NASw-1695)
(NASA-TT-F-12802) Avail: CFSTI CSCL 20D

Secondary flow occurs in turbulent fluid flows in direct channels of noncircular cross section in a plane perpendicular to the direction of the main flow. The secondary flow exerts a significant influence on transfer processes in turbulent flows. The article is devoted to an examination of problems associated with secondary flow calculation. The numerical solution of the problem is based on the Reynolds equation. Author

N70-18870 Wisconsin Univ., Madison.
RHEOLOGICAL EQUATIONS FROM MOLECULAR NETWORK THEORIES
Pierre Jean Carreau (Ph.D. Thesis) 1968 188 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 68-17880

Logde's molecular network theories cannot account for the rate of strain dependence of various material functions. By allowing the junction-creation rate and the probability of loss of junctions to depend on the second invariant of the rate of strain tensor, more realistic constitutive equations were obtained. Two rheological models are proposed by assuming two different mechanisms for the effect of the rate of strain on the kinetics of the network. The experimental data on eight fluids (six polymer solutions, one soap solution and one polymer melt) are used to test the models in various flow situations. For steady simple shearing and small amplitude, sinusoidal simple shearing, both model A and model B are capable of fitting the four functions rather well over many

decades of shear rate or frequency. Model B however appears to be the only rheological equation which can fit simultaneously the steady shear, complex viscosity, stress growth, and stress relaxation functions. For stress growth, the agreement with the experimental data is remarkable, especially after the other models were shown to fail drastically. Dissert. Abstr.

N70-18881 Syracuse Univ., N.Y.
MOTION AND MASS TRANSFER OF FLUID SPHERES IN NON-NEWTONIAN MEDIA
Yoshisuke Nakano (Ph.D. Thesis) 1968 160 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-7762

An analytical study on the flow of a non-Newtonian power law fluid over a Newtonian fluid sphere and the related mass transfer problem is made. The study of the flow is divided into two parts according to the flow regimes. For the creeping flow case, a technique which combines the variational principle and Galerkin's method is developed for its solution. For the intermediate Reynolds number case, the solution is obtained using Galerkin's method. In either case, the agreement between the experimental and present work is reasonable. Two approaches are used for the studies of mass transfer in continuous phase. Boundary layer solutions are obtained for two limiting cases, the immobile interface and the fast moving interface. In addition, a finite difference method is developed for the solution of the complete diffusion equation. Comparisons are also made between the predicted results and the experimental data available in the literature. Dissert. Abstr.

N70-18894*# Techtran Corp., Glen Burnie, Md.
THE CALCULATION OF SUPERSONIC AXISYMMETRIC FLOWS USING THE RESULTS OF OPTICAL MEASUREMENTS [RASCHET SVERKHZHVUKOYVKH OSESIMMETRICHNYKH POROKOV S ISPOLZOVANIEM REZULTATOV OPTICHESKIKH IZMEREIIY]
E. P. Kazandzhan et al Washington NASA Jan. 1970 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 4, Jul.–Aug. 1969 p 146–148
(Contract NASw-1695)
(NASA-TT-F-12799) Avail: CFSTI CSCL 20D

Calculation results of gas dynamic functions of supersonic axisymmetric flows are discussed. The problem involves the quantitative investigation of gas flows by means of optical methods. Author

N70-18908*# Alabama Univ., University. Bureau of Engineering Research.
TWO PHASE FLOW AND HEAT TRANSFER IN POROUS BEDS UNDER VARIABLE BODY FORCES, PART 1 Final Report
Julian O. Doughty and Harold R. Henry Nov. 1969 37 p refs
(Contract NAS8-21143)
(NASA-CR-108137; Rept-113-30-Pt-1) Avail: CFSTI CSCL 20D

Outlined are proposed analytical studies and laboratory experiments to determine the behavior of two phase vapor-liquid and/or gas-liquid flow through porous beds, screens, and membranes in low gravity environments. A major objective of this experimentation is to collect data useful in solving practical problems of manned space exploration, as well as water purification schemes, oil and gas production from porous geological formations, contaminant disposal in ground water areas, and flow through packed beds in chemical engineering processes. G.G.

N70-18938*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SIMPLIFIED MOLECULAR MODEL FOR STUDYING VIBRATION-DISSOCIATION COUPLING IN FLUID FLOWS
Walter Albert Reinhardt Washington Sep. 1969 333 p refs
(NASA-TR-R-324; A-3277) Avail: CFSTI CSCL 20D

A simplified mathematical model is derived that is useful for studying the effects of vibration-dissociation coupling in fluid flows. The derivation is based on an energy-moment procedure for simplifying the master equations. To obtain the model equations it is assumed that the vibrational energy can be approximated by the introduction of two vibrational temperatures. The effects of molecular anharmonicity are also accounted for in an approximate manner. The parameters contained within the equations are evaluated by making comparisons with experimental data. It is shown that the model contains the minimum required structure allowing favorable agreement with existing experimental data. Numerical solutions are given for the quasi-steady zone behind a normal shock wave, for the complete structure of a shock wave, and for nozzle flow. The results provide the appropriate pre-exponential temperature dependence of the effective dissociation rate, yield an induction time before dissociation is observed, and, in the case of expanding flow, yield one-fourth less effective relaxation time than the Landau–Teller theory. The thermodynamic quantities for the vibrational mode (partition function, internal energy, and specific heat) agree accurately with like quantities evaluated from spectroscopic data. By the introduction of appropriate assumptions it is shown that the equations reduce to a form identical to the Marrone–Treanor model except for a "truncation factor." When the vibrational temperatures are not large, the model is identical to that of Landau and Teller. The numerical procedure used to integrate the system of rate and flow equations is also described. Author

N70-18963*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SURVEY OF LITERATURE ON FLOW CHARACTERISTICS OF A SINGLE TURBULENT JET IMPINGING ON A FLAT PLATE
James W. Gauntner, John N. B. Livingood, and Peter Hrycak (Newark Coll. of Eng.) Washington Feb. 1970 45 p refs
(NASA-TN-D-5652; E-5203) Avail: CFSTI CSCL 20D

Flow characteristics of single jets impinging on flat surfaces have been studied by many investigators. The results of some of the numerous studies are summarized herein. Suggested methods for determining velocities and pressures on which to base heat-transfer correlations for use in impingement cooling design are presented. Author

N70-18973 Maryland Univ., College Park.
INVESTIGATION OF THE DEFORMATION AND PENETRATION OF A TURBULENT, SUBSONIC JET ISSUING TRANSVERSELY INTO A UNIFORM, SUBSONIC MAIN STREAM
Richard Selmer Reilly (Ph.D. Thesis) 1968 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9582

The flow field was studied optically by injecting smoke into the jet and using flash photographs and high speed movies to define the behavior of the jet. Experimental results indicate that there is a periodic formation of eddies in the jet. These eddies are an order of magnitude larger than the ones which are present in a free turbulent jet of the same Reynolds number. The high speed movies show that there is an eddy shedding phenomenon from the sides of the circular jet which is similar to the Von Karman vortex street behind a solid circular cylinder. The length to width ratio of the jet nozzle was systematically varied and the jet penetration was increased when the nozzle was oriented with the larger dimension parallel to the main stream. Experimental results indicate that the nozzle length to width ratio for maximum penetration is a function of the ratio of jet exit velocity to main stream velocity. Dissert. Abstr.

N70-18983*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LOW-GRAVITY LIQUID-VAPOR INTERFACE CONFIGURATIONS IN SPHEROIDAL CONTAINERS

Jack A. Salzman Washington Feb. 1970 19 p refs
(NASA-TN-D-5648; E-5304) Avail: CFSTI CSCL 20D

An experimental investigation was conducted to determine the equilibrium liquid-vapor interface configuration in oblate spheroids in low-gravity environments. Static contact angles of the test liquids on the spheroid surfaces were restricted to near 0 deg. The experiments were conducted in low-gravity environments ranging from 0.00001 to 0.031 g and at system Bond numbers ranging from effectively zero to 30. Oblate spheroidal tanks were tested with eccentricities of 0, 0.50, 0.68, and 0.80 and semimajor axes of 2.0, 3.0, and 4.0 centimeters. Both quantitative and qualitative data were obtained on the liquid-vapor interface, and these data were compared with previous analytical predictions. Of particular interest were those interface configurations where the tank bottom became void of liquid. Author

N70-18990# Wisconsin Univ., Madison. Mathematics Research Center.
ON THE CONSTRUCTION OF MOTIONS WITH CONSTANT STRETCH HISTORY. PART 2: MOTIONS SUPERPOSABLE ON SIMPLE EXTENSION AND VARIOUS SIMPLIFIED CONSTITUTIVE EQUATIONS FOR CONSTANT STRETCH HISTORIES
R. R. Huilgol Apr. 1969 55 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-696323; MRC-TSR-975) Avail: CFSTI CSCL 20/4

The article discusses the form of the most general motion with constant stretch history and the material functions in that flow. Simplified constitutive equations for a broad class of non-viscometric motions are presented and the material functions for two such flows are related to viscometric material functions. Author (TAB)

N70-18995*# Techtran Corp., Glen Burnie, Md.
TWO-SPEED THEORY OF FLOW AROUND A THIN PROFILE [DVUKHSKOROSTNAYA TEORIYA OBTEKANIYA TONKOGO PROFILYA]
Kh. A. Rakhmatulin et al Washington NASA Jan. 1970 7 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 4, Jul.–Aug. 1969 p 32–35
(Contract NASw-1695)
(NASA-TT-F-12789) Avail: CFSTI CSCL 20D

A hydrodynamic diagram of supersonic flow around a thin body by a two-phase medium is examined. The problem is simplified by establishing phase boundaries and then finding the corresponding profile (an inverse problem). An analytical solution of the inverse problem is given. Author

N70-18996*# Techtran Corp., Glen Burnie, Md.
HEAT EXCHANGE IN THE REGION OF INTERACTION OF AN AXISYMMETRIC SUPERSONIC STREAM WITH AN OBSTACLE [TEPLOOBMEN V OBLASTI VZAIMODEYSTVIYA OSESIMMETRICHNOY SVERKHZVUKOVOY STRUI S PREGRADOY]
N. Ye. Khramov et al Washington NASA Jan. 1970 8 p Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (Moscow), no. 4, Jul.–Aug. 1969 p 134–136
(Contract NASw-1695)
(NASA-TT-F-12797) Avail: CFSTI CSCL 20D

The results are discussed of the calculation of heat exchange at a critical point under the influence of an incompletely expanded gas stream on obstacles consisting of a sphere and a plane wall. Author

N70-19001 Wisconsin Univ., Madison.
FALLING FILMS: HYDRODYNAMICS AND MASS TRANSFER
Claude Massot (Ph.D. Thesis) 1968 298 p
Avail: Univ. Microfilms: HC $13.50/Microfilm $3.85 Order No. 69-16004

The hydrodynamics of rippling in laminar falling films was investigated both theoretically and experimentally, and the results of these investigations were used to analyze mass transfer across the free film surface. This analysis led to a priori predictions of mass transfer rates in excellent agreement with available experimental data. While the degree of agreement is to some extent fortuitous, it is believed that useful insight has been gained into the behavior of mass transfer apparatus employing supported laminar films. The hydrodynamic analysis was based on the assumption of periodic flow and consisted of an approximate solution of the hydrodynamic equations governing flow in thin films of Newtonian liquids. It is an extension of earlier work by Kapitza and others and yields improved agreement with experiment. Dissert. Abstr.

N70-19088*# Case Western Reserve Univ., Cleveland, Ohio. School of Engineering.
OBSERVATION OF FLOW EXCURSIONS IN A SIMULATED GAS-COOLED REACTOR PASSAGE
Paul Vingerhoet, Edward R. Kolbe, and Eli Reshotko Washington NASA Feb. 1970 33 p refs
(Grant NGR-36-003-064)
(NASA-CR-1538) Avail: CFSTI CSCL 20D

The steady state characteristics of helium gas flowing in an electrically heated Nichrome V tube 0.094 in. ID by 54 in. long were obtained for laminar, transitional and turbulent flow. Excursions at constant pressure drop from an unstable laminar equilibrium point to a stable turbulent equilibrium point were triggered and observed. The results substantiated the theory of Reshotko in showing that the time history of an excursion is directly related to the heat capacity of the core and that an excursion is nonviolent and non-oscillatory in nature. Author

N70-19103 Purdue Univ., Lafayette, Ind.
AN INTEGRAL METHOD OF SOLUTION FOR A HYPERSONIC BLUNT BODY SHOCK LAYER, INCLUDING VISCOUS AND NONGRAY RADIATION EFFECTS
Raymond Kenneth Burns (Ph.D. Thesis) 1968 235 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-7428

A study was made of an integral method of solution of the momentum and energy conservation equations for a shock layer formed around a blunt body in hypersonic flow. The integral procedure is similar to the Karman-Pohlhausen technique used in boundary layer analysis and has previously been applied to the hypersonic blunt body problem. The primary objectives of this study were to generalize the method to include the upstream influence and to obtain solutions for wide angle blunted conical bodies and for CO2-N2 atmospheres. The flow considered was laminar, steady and axisymmetric. The effects of viscosity and conduction, of dissociation and ionization of the gas, and of nongray radiative emission and self absorption were included. The body surface was assumed to be at a uniform and relatively low temperature. The complete development of the thin shock layer integral conservation equations is presented and the upstream influence mechanism in the formulation is discussed. Dissert. Abstr.

N70-19114 Nebraska Univ., Lincoln.
A NEW TECHNIQUE FOR MEASURING RADIAL DISPERSION IN A MOVING FLUID
Olaf Martin Stokke, Jr. (Ph.D. Thesis) 1968 74 p
Avail: Univ. Microfilms: HC $4.00/Microfilm $3.00 Order No. 69-9650

A new method is proposed and tested for measuring radial mixing. Previous methods have required knowledge of the concentration of some dispersing component as a function of position in the system. This in turn has necessitated positioning within the system some form of sampling device such as a pitot probe. Samples of fluid could then be with-drawn and analyzed for tracer content. Unfortunately, such techniques create disturbances in the flow system. The present approach circumvents this problem by

making all measurements from outside the system. The apparatus is essentially a spectrophotometer consisting of a narrow beam helium-neon gas laser as the light source and a silicon diode as the photosensitive device. The cell is a thin-walled glass column approximately 2.75 inches in diameter. This apparatus was tested on a single phase system of water flowing at a Reynolds number of 27,600. Dissert. Abstr.

N70-19146 Lehigh Univ., Bethlehem, Pa.
ATTENUATION OF INLET FLOW DISTORTION UPSTREAM OF AXIAL FLOW COMPRESSORS
Gary Michael Callahan (Ph.D. Thesis) 1968 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-7327

An analytical and experimental investigation of the flow redistribution upstream of a low hub-tip ratio axial flow compressor operating with a total pressure inlet distortion originating far upstream of the compressor was completed. In the analyses, the inlet distortion was assumed to be a small perturbation of the main flow. Analyses were developed in both rectangular cartesian and circular cylindrical coordinate systems and allow for radial and circumferential variations of the inlet flow. They also account for radial variations of the pressure rise vs. mass flow rate characteristic of the compressor and include the effect of the inlet Mach number. An experimental investigation was conducted using a low hub-tip ratio axial flow compressor. Three dimensional velocity and pressure surveys were obtained upstream of the compressor for three different total pressure distortions imposed far upstream of the compressor. In comparing the experimental results and the analysis, it was found that local static pressure vs. mass flow rate characteristic of the compressor was strongly influenced by the presence of the distortion. Dissert. Abstr.

N70-19147*# Techtran Corp., Glen Burnie, Md.
DETERMINATION BY THE METHOD OF CHARACTERISTICS OF SUPERSONIC FLOWS ASSOCIATED WITH A GIVEN PRESSURE LAW [DETERMINATION PAR LA METHODE DES CARACTERISTIQUES D'ECOULEMENTS SUPERSONIQUES ASSOCIES A UNE LOI DE PRESSION DONNEE]
Pierre Diringer Washington NASA Feb. 1970 26 p Transl. into ENGLISH from Rech. Aerospatiale (French), no. 130, 1969 p 3-15
(Contract NASw-1695)
(NASA-TT-F-12784) Avail: CFSTI CSCL 20D

The method of characteristics is used for computing jets and wakes when the pressure distribution is previously given at the boundary. A computing method appropriate to each point of the field and of its boundaries (shock waves, expansion waves, jet or wake) is described. The ensuing computing program applies to real gases (air) as well as to perfect gases for two dimensional or axially symmetric flows. Examples concern, in the case of perfect gases, the calculation of a jet line, and the calculation of shock waves in an entropy layer downstream, a cylinder, while in the cases of real gases it permits the calculation of the flow downstream a blunt nosed cone is hypersonic flight. Author

N70-19197 California Univ., Davis.
DISCONTINUOUS UNSTEADY FLOW IN OPEN CHANNELS
George Terzidis (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-8978

The one-dimensional equations describing unsteady flow with steep-fronted surges in open channels were derived in integrated form by applying the laws of conservation of mass and momentum in a deformable control volume. A general computational scheme was constructed based on the integrated equations and arbitrary position of the discontinuity. Two explicit computational schemes were chosen on the basis of stability, accuracy, and simplicity. The first scheme is called the simple explicit scheme and the second is called the two-step Lax-Wendroff-Richtmyer explicit scheme. The two methods have been applied to the numerical solution of several unsteady open-channel flow problems with shock waves. The numerically predicted propagation velocity of the shock wave and the time variation of the free surface proved to be in satisfactory agreement with experiments. Dissert. Abstr.

N70-19198 Wisconsin Univ., Madison.
THE EFFECT OF PERIODIC SHOCK-FRONTED PRESSURE WAVES ON THE INSTANTANEOUS HEAT FLUX AT THE END-WALL OF A TUBE
Raymond William Goluba (Ph.D. Thesis) 1968 195 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 68-17896

Pressure oscillations in a frequency range of 479-881 Hz, with amplitudes up to 175 psi peak-to-peak, were obtained with time-averaged tube pressures from 40 to 190 psia. The instantaneous heat flux at the center of the end-wall was calculated from the surface temperature oscillation as measured by a thin platinum resistance film deposited on a Pyrex surface inserted into the end-wall. The thermal boundary layer was thin, compared to the wavelength of the oscillation. The pressure variation with time was provided from the experimental data. The unsteady energy equation was numerically solved by a finite difference predictor-corrector method for the case of a zero net heat transfer at the end-wall. The theory and the experimental data show that the instantaneous heat flux rates increase as the pressure ratio across the wave increases and are directly proportional to the square root of the product of the frequency and the time-averaged pressure of the oscillation. Dissert. Abstr.

N70-19210 Case Western Reserve Univ., Cleveland, Ohio.
THE ac JOSEPHSON EFFECT IN SUPERFLUID HELIUM
Brij Mohan Khorana (Ph.D. Thesis) 1968 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9427

Two superfluid helium baths were linked to each other through a small orifice. A quartz transducer produced a sound wave in the vicinity of the orifice, which served to couple the rate of vortex formation to the sound frequency. With the sound turned off, the gravitational flow through the orifice showed the weak dependence on the pressure head. When the sound was turned on after the level inside the breaker had reached equilibrium, the liquid began to be pumped out of the beaker and the arrest of the flow at certain liquid levels was observed. A model for the phase-slippage, due to the motion of quantized vortex rings, which can account for the observed effect is proposed. The stability of the liquid level at one of the 'steps' appears to be indefinite; once arrested, the liquid remains arrested until disturbed by fluctuations. Dissert. Abstr.

N70-19221 Pennsylvania State Univ., University Park.
THERMAL SEPARATION CONTROL APPLIED TO ELECTRO-FLUIDIC SWITCHING IN A STRAIGHT-WALLED DIFFUSER
Reinhold Ernst Tomek (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 69-9814

It is necessary that the divergence of the walls be large enough to cause the power jet to adhere, immediately downstream from the throat, to only one of the diverging walls (the preferred wall). This attachment, often referred to as the Coanda Effect, is accompanied by back-flow along the other diverging wall. Under these conditions of flow, heating the preferred wall will cause the jet to separate from the preferred wall and switch over to the other wall (the nonpreferred wall). This occurs over a wide range of flow rates. Subsequent heating of the non-preferred wall instead of the preferred wall (or eliminating heating entirely) will cause the jet to switch back to the preferred wall. Experimental studies of the time required for jet switching showed that in the large model, jet switching occurred in as little as 1.5 seconds. In the small model

(having a divergence angle of 16 degrees), jet switching occurred in as little as .125 seconds with 20 watts of heater power. Dissert. Abstr.

N70-19222 Iowa State Univ. of Science and Technology, Ames.
A METHOD FOR COMPUTING THE PRESSURE DISTRIBUTION ABOUT AN AXISYMMETRIC NACELLE IN SUBSONIC FLOW
Darryl Jon Trulin (Ph.D. Thesis) 1968 54 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9898

In the design of an aircraft utilizing an air-breathing engine located in a cowling or nacelle external to the main airframe, the flow field characteristics about the engine housing must be known. The velocity at a point in the flow field due to this frustum of vorticity is expressed by integrating the ring vortex function along the frustum surface. The resulting expression can be written in terms of a geometry dependent integral and the two unknown strengths at the frustum bases. The usual boundary condition of tangential flow at the body surface is expressed in equation form at each of the frustum midpoints. Each equation consists of a summation of terms that involve an unknown value of surface vortex strength at a frustum junction multiplied by a complex geometry dependent coefficient. Since there is one more frustum base than there are midpoints, a modified Kutta condition equation is added. The inversion of the matrix of equations yields the vorticity distribution satisfying both the tangential flow requirement and the Kutta condition. The velocity and pressure field about the nacelle can then be found from this vortex distribution. Dissert. Abstr.

N70-19300 Cornell Univ., Ithaca, N.Y.
CROSSED-FIELDS MAGNETOGASDYNAMIC FLOWS OVER CONDUCTING BODIES
Demetrius Panayiotis Lalas (Ph.D. Thesis) 1968 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-5764

The effect of a conducting body in crossed-fields MGD flow is studied. The induction drag mechanism for large satellites and the waves that are excited by bodies in the ionosphere are clarified. Although infinite conducting bodies are found to have no effect on the flow field, flows along infinite conducting bodies are studied to establish the electromagnetic effects of the current in the body and the flow. Then compressible MGD flow over three-dimensional bodies is investigated. A Fourier transform technique is used to synthesize the flow over small and large aspect-ratio slender bodies. The effects of the Hall conductivity have also been analyzed, by the use of the same Fourier transform technique. Dissert. Abstr.

N70-19349*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
UNSTEADY JET FLOW OF A VISCOUS FLUID [O NESTATSIONARNOM STRUYNOM DVIZHENII VYAZKOY ZJIDKOSTI]
L. A. Vulis et al Washington NASA Jan. 1970 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), Mar.-Apr. 1969 p 19-25
(Contract NASw-1692)
(NASA-TT-F-12635) Avail: CFSTI CSCL 20D

A solution is derived, within the framework of boundary layer theory, to the problem of a nonstationary flow created by a plane jet source with a given time law for the momentum flow. Particular cases of aperiodic and periodic variation of the momentum are discussed. Characterization of the pulsating flow is accomplished by a qualitative anology with turbulent motion. Author

N70-19387 Pennsylvania State Univ., University Park.
THE INTEGRAL EQUATION FORMULATIONS FOR THE LOW REYNOLDS NUMBER HYDRODYNAMICS
Grace Ping-Poo Ho (Ph.D. Thesis) 1968 118 p
Avail: Univ. Microfilms: HC $5.80/ Microfilm $3.00 Order No. 69-9768

A unified treatment for the motion of an incompressible fluid at low Reynolds numbers is presented. The topics considered are those related to the translational and rotary motion of various bodies in a fluid region. Both the steady and the unsteady cases are discussed. The method employed is based on the theory of integral equations similar to the idea of Green's function in potential theory. In each case, a Green's tensor is found and an integral representation of the flow field is formed. The corresponding integral for the bounded fluid region is derived as a first order correction. Similar representation for the unsteady motion of various bodies in an unbounded medium are derived. Using the integral representation of the flow field, a formula is derived for the force (or the torque) exerted on the body by the fluid due to its motion in a bounded fluid region. Dissert. Abstr.

N70-19408# Naval Ship Research and Development Center, Washington, D.C.
A THEORY OF CAVITY FORMATION AT SOLID-LIQUID INTERFACES
Donald J. Cotton Sep. 1969 19 p refs
(AD-693990; NSRDC-3054; MATLAB-352) Avail: CFSTI CSCL 20/4

A theory of cavity formation at solid-liquid interfaces was derived which describes cavitational behavior in terms of the dispersion forces and of the surface tension of the liquid. The resulting relationships are easily applied to experimental data with which they have been successfully tested. Author (TAB)

N70-19439# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Quarterly Progress Report, 1 Apr.-30 Jun. 1969
Aug. 1969 17 p refs
(Contract AT(03-4)-189)
(GEAP-10067; QPR-15) Avail: CFSTI

Subchannel sampling tests were continued in the side and center subchannels. Results of measurements of the mass velocity and enthalpy for these subchannels and the overall trends are reported. Pressure drop results for the nine-rod assembly are also given. Author (NSA)

N70-19465 Utah Univ., Salt Lake City.
HOT-FILM CHARACTERISTICS IN A TURBULENT BOUNDARY LAYER WITH FOREIGN-GAS INJECTION
Thomas Hadwick Smith (Ph.D. Thesis) 1969 275 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.55 Order No. 69-6015

The primary objective of this investigation was the study of concentration effects upon the behavior of hot film sensors in a turbulent boundary layer with foreign gas injection. A theory was derived which indicated the effect of concentration variations upon both the time-averaged and the fluctuating sensor response, which appeared as the output of a conventional constant temperature anemometer, linearizer, rms-voltmeter system. It was concluded that the effects of concentration upon sensor mean and fluctuating behavior in the turbulent boundary layer were significant for the injection rates employed and were in agreement with the theory. Two related investigations are also reported: a new method to facilitate determination of the skin friction coefficient in foreign gas-injected turbulent boundary layers was developed, based on a modified law of the wall equation for this environment, and a new, simplified method for the determination of profiles of the turbulent shear stress, the turbulent heat flux, the eddy viscosity, the eddy conductivity, and the turbulent Prandtl number across the boundary layer was devised and applied. Dissert. Abstr.

N70-19467# Los Alamos Scientific Lab., N.Mex.
TURBULENCE DISTORTION IN A NONUNIFORM TUNNEL

Francis H. Harlow and N. C. Romero Aug. 1969 12 p refs
(Contract W-7405-eng-36)
(LA-4247) Avail: CFSTI

Homogeneous turbulence passing through a tunnel of nonuniform cross section is altered in scale, in total energy content, and in the distribution of energy among the directional components. Previous theories have explained the results for rapid distortions of small magnitude, but disagree with experiments in which there are relatively slow distortions of large magnitude. It is shown how computer solutions of the full turbulence transport equations can describe the principal features of all the available experiments.
Author (NSA)

N70-19542# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Quarterly Progress Report, 1 Jan.-31 Mar. 1969
Apr. 1969 18 p refs
(Contract AT(04-3)-189)
(GEAP-10055; QPR-14) Avail: CFSTI

Work connected with subchannel flow tests in the nine-rod test section is described. The work included calibration of calorimeter (i.e., determination of heat loss), determination of Delta P setting for isokinetic sampling in the corner subchannel, single- and two-phase sampling of corner subchannel flow, and single- and two-phase pressure drop. Results were tabulated and plotted. The results showed that, in the range of conditions tested, both the mass velocity and the quality in the corner subchannel were less than the average for the channel. The mass velocity in the corner subchannel appeared to approach the average channel value at qualities corresponding to transition from slug to annular flow.
Author (NSA)

N70-19551# Akademiya Nauk URSR, Kiev.
DYNAMICS OF CIRCULATING AND WAVE FLOWS, ISSUE 3
1968 146 p refs In RUSSIAN
Avail: CFSTI

Results are presented on methods of predicting alteration of shorelines, the interaction of wind-induced waves and coast lines, designing protective structures for beaches and shorelines, and the hydrodynamics of helical flow of liquids in pipes. For individual titles see N70-19551 to N70-19572.

N70-19557# Odessa Inst. of Marine Engineers (USSR).
DETERMINING THE TOTAL AMOUNT OF ABSOLUTE CONCENTRATION OF DETRITUS
G. S. Bashkirov *In* Akad. Nauk URSR Dyn. of Circulating and Wave Flows, Issue 3 1968 p 43-48 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

The absolute turbidity due to bottom erosion by different sizes of soil particles is considered. Experiments show that slight displacement of lighter particles occurs during initial wave action. The particles accumulate in clusters and generate larger vortices as the wave parameters increase. The soil particles begin to rise into the mass of the wave current without being carried in its main nucleus. Massive erosion of all remaining particles then begins, which corresponds to the maximum depth of bottom erosion. The light particles are taken from the boundary layer by the wave current and are transformed into a suspension. The heavier particles are then eroded and finally the light, adhesive, entrapped particles suddenly enter the upper layers of the wave current, thus escaping the phase of bottom motion. Boundary layer theory of two-phase turubient flow, experimental data on sea channels, and concepts of diffusion theory are applied to calculation of the absolute amount of detritus carried in wave currents. Transl. by R.B.

N70-19558# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
SHORELINE DYNAMICS IN THE ZONE OF WAVE FLOWS SATURATED WITH DETRITUS
V. N. Sidorchuk and V. Z. Averin (Kiev Polytech.) *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 49-53 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Functions are derived for calculating the time variation of the incline factor of an underwater slope from the line of the cut to the lower limit of the eroding wave action. Transl. by H.W.

N70-19561# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
THE TURBULENCE OF SHORELINE CURRENTS
Ye. I. Safronova *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 61-64 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

A first approximation is given for the turbulence of wave currents and the distribution of the turbulence is determined along the width of the slope in the pre-erosion zone at different inclines. Point velocities were measured by an inductive transducer and surface and submerged floats were photographed. It is shown that the root-mean-square error in the velocity of shoreline currents is at a maximum in the zone where the waves break up. This error is related to mean flow velocity by a linear function, as in the case of channel flow. Transl. by R.B.

N70-19562# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
USING ELECTROMODELING TO DETERMINE THE TRAJECTORY OF LIQUID PARTICLES DURING WAVE MOTION
V. I. Vechorek and R. V. Bregman *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 65-74 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

A device for the electrohydrodynamic method (EGDA) is employed for the case of regular progressive gravitational waves of an ideal liquid. Because the motion of liquid particles in this case is unsteady and cannot be modeled on the EGDA device, the motion must be reduced to steady mode. Trajectories can be obtained for cases which are difficult to model by theoretical analysis, such as shallow depths and high waves. Once the liquid particle trajectories have been found, the values of their drift and distribution in depth are derived automatically, which permits application in solving problems of mass transfer. Transl. by R.B.

N70-19564# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
CALCULATING THE RESISTANCE OF CHANNEL AND RESERVOIR BOTTOMS DURING WIND-INDUCED FLOODING
V. I. Shvets *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 82-92 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Existing Chezy formulas are analyzed and the formula is selected which is most suitable for calculating the curves of the water surface hydrostatic head in water flows with large hydraulic radii. Comparison of existing formulas with full-scale observation shows that the Chezy factor in the zone of ebb and flow phenomena of channel and canal surfaces can be calculated only on the basis of full-scale measurements and that no universal formulas exist at present for accurate calculation of water flows with large hydraulic radii. Transl. by R.B.

N70-19568# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
USING WAVE ENERGY TO PROTECT PORTS AND WATER INLETS FROM LITTORAL DRIFT
N. A. Grushchenko *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 123-126 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

A complex of structures was developed and tested in a wave tank to create an artificial discontinuous flow, which hinders the deposition of littoral drift at the entrance to a port or water inlet. A system of channels, by use of which the water is lifted, adjoins the jetty or is built into it. Transl. by H.W.

N70-19569# Akademiya Nauk URSR, Kiev.
OPERATIONAL ANALYSIS OF A FLEXIBLE FLOATING BREAKWATER
V. V. Buryachok (Min. of the Maritime Fleet) *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 127-132 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Simple theoretical functions were derived which describe wave action in front of and behind a breakwater. Calculations show that the principle factor in wave reflection is the added mass of the water. This indicates the possibility of achieving practically acceptable levels of wave attenuation at minimum required values of overbuoyancy. Transl. by H.W.

N70-19570# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
THE EFFECT OF THE DIFFERENCE IN MEAN VELOCITIES OF SOLID AND LIQUID PHASES ON THE DYNAMIC CHARACTERISTICS OF A FLOW DURING MOTION OF A HYDRAULIC FLUID IN PIPES
S. G. Kobernik *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 133-140 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

It is shown that the pressure losses during the motion of a hydraulic fluid in the case of uniform density distribution and the lack of asymmetry is equal to the pressure losses during the motion of water. The analysis shows that in order to develop the theory of non-uniform suspension-carrying flows, it is necessary to consider the redistribution of the mean velocities of the liquid and solid phases which occur due to the asymmetry of flow rates and the uneven density distribution along the pipe cross section. Transl. by R.B.

N70-19571# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
THE KINEMATIC STRUCTURE OF A HELICAL FLOW OF WATER IN A CIRCULAR PIPE
G. B. Dokukin, V. S. Perekhrest, and M. Z. Guzov *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 141-146 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Experiments show that the axis of a helical flow created by gated guides does not coincide with the geometric axis of the pipe. The maximum values of the tangential and radial components of velocity are commensurate with the mean velocity. Transl. by H.W.

N70-19572# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
INVESTIGATING THE TRANSPORT CAPACITY OF SUSPENSION-CARRYING FLOWS IN PARTIAL MUD-FILLED PIPES WITH HELICAL MOTION OF THE SLURRY
B. A. Pyshkin, G. B. Dokukin, and V. S. Perekhrest *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 147-151 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Partial or total elimination of mud accumulation during normal movement of a slurry in pipes is achieved by reducing the consistency and by flushing the pipe with water. In order to prevent prolonged shutdowns of the pumping equipment, normal flow is converted to helical flow, which causes the tangential and radial velocity components to alter the kinematic structure and dynamic characteristics of the suspension-carrying flow. The radical alteration of the velocity and consistency distribution curves in the pipes increases the transport capacity of the flow. Transl. by R.B.

N70-19601# Lockheed Missiles and Space Co., Palo Alto, Calif.
DIFFERENCE SCHEMES WITH THIRD ORDER ACCURACY FOR THE THROUGH ANALYSIS OF DISCONTINUOUS GASDYNAMIC PROBLEMS
V. V. Rusanov [1969] 12 p refs Transl. into ENGLISH of Inst. Prikl. Mat. AN SSSR report
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A two-level explicit difference scheme of third order accuracy, based on an extension of the Runge-Kutta method, is constructed for a general hyperbolic system. The scheme permits obtaining numerical discontinuous solutions of gasdynamics problems by the composition computation method. Examples of such solutions in Lagrange and Euler coordinates are presented. Author

N70-19623# Rensselaer Polytechnic Inst., Troy, N.Y.
BUBBLE RISE VELOCITIES IN TWO-DIMENSIONAL GAS FLUIDIZED BEDS FROM PRESSURE MEASUREMENTS
Howard Littman and George A. J. Homolka 20 Mar. 1969 34 p refs Presented at the 64th Natl. A. I. Ch. E. Meeting, New Orleans, 20 Mar. 1969
(RPI-3639-11; CONF-690307-4) Avail: CFSTI

Bubble rise velocities were determined from pressure time measurements along the vertical axis of symmetry of injected bubbles in a two dimensional gas fluidized bed. Author (NSA)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N70-18308# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE COLD EARTH
Willis L. Webb Oct. 1969 29 p refs
(AD-697106; ECOM-5272) Avail: CFSTI CSCL 4/2

From a conduction viewpoint, the earth represents a heat sink in the solar atmosphere. Mesopause temperatures range between 135K and 220K in the 80 km region, with the coldest portion in summer high latitudes. This region of low temperature in the earths atmosphere is indicated to be maintained by turbulent flow in the 50-110 km region. Through thermodynamic processes in the gravity field, turbulence transports heat downward toward the stratopause from the hot solar atmosphere. The mode of heat conduction is complex as a result of interactions between the solar plasma and the earths electromagnetic environment. It is shown that this conduction mode of heat transport has a significant impact on the heat distribution of the upper atmosphere. Author (TAB)

N70-18317# RAND Corp., Santa Monica, Calif.
MEASUREMENT OF OCEAN WAVES IN A SATELLITE PHOTOGRAPH
L. M. Libby, W. F. Libby (Calif. Univ., Los Angeles), and S. S. Lawrence (Calif. Univ., Los Angeles) Oct. 1969 10 p refs
(AD-696492; P-4230) Avail: CFSTI CSCL 8/3

Apollo 8 photographs of the surface of the ocean, made within two hours of noon solar time are found to show wave structure of the sea with remarkable clarity. The wave length distribution has been measured from about 1000 waves in a single photograph of about 10,000 sq mi area. With better photographic definition wave height could probably also be measured from deformation of edges of cloud shadows. Using this method it would be possible to measure wave length and wave height distributions daily of all oceans, with a polar orbiting satellite carrying a television camera. Author (TAB)

N70-18333# National Aerospace Lab., Tokyo (Japan).
MEASUREMENT AND ANALYSIS OF ATMOSPHERIC TURBULENCE OVER THE SUZUKA MOUNTAIN RANGE
Kazuyuki Takeuchi, Koichi Ono, Kosaburo Yamane, Toichi Oka, and Tokuo Sotozaki 1969 43 p refs In JAPANESE; ENGLISH summary
(NAL-TR-180) Avail: CFSTI

Measurements on atmospheric turbulence were made on air route GREEN 4 over the SUZUKA Mountains, which was thought to be comparatively gusty among domestic air routes. The experiment was carried out in cooperation with Meteorological Research Institute, but this report was concerned only with measurements made by airplane. A tape recorder with fourteen tracks was used to record normal and horizontal accelerations and angular velocities at C.G. to give the airplane attitude, as well as the airspeed and the wind directions measured by flow vanes attached to the nose and wing tip. The wind direction was used to obtain the turbulence velocities. Temperature, altitude, and displacements of the control surfaces were also recorded. The data were analyzed to obtain the turbulence spectrum and the relationship between the measured items including temperature.
Author

N70-18355# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

A DIMENSIONLESS SOLUTION FOR THE WIND AND TEMPERATURE PROFILES IN THE SURFACE BOUNDARY LAYER

Frank V. Hansen and Juana Serna Fort Monmouth, N.J. ECOM Sep. 1969 179 p refs
(AD-697109; ECOM-5267) Avail: CFSTI CSCL 4/1

The shape of the wind and temperature profiles in the surface boundary layer of the atmosphere for thermally stratified flow is presented as dimensionless parameters. The development of the hypothesis follows dynamic similarity as applied to the atmosphere near the earths surface. The approach used for thermally stratified unstable flow assumes the scaling ratio, z/L, is numerically equivalent to the gradient Richardson number, Ri. In stable air, z/L is taken as a function of Ri. The Richardson number is considered to be the sole controlling parameter of similarity in the surface boundary layer over a large stability range from approximately Ri = -5.0 to Ri = 0.204. A Richardson number of 0.204 is taken to be the nominal critical value at which turbulence experiences a complete decay and denotes the onset of undulance.
Author (TAB)

N70-18375*# Texas A&M Univ., College Station. Dept. of Oceanography.

CHARACTERISTIC PATTERNS OF RIVER OUTFLOW IN THE MISSISSIPPI DELTA

Don Walsh Jun. 1969 246 p refs Sponsored by NASA
(Contract N62306-69-C-0263; A and M Proj. 658)
(NASA-CR-107936; AD-694420; Rept-69-8-T) Avail: CFSTI CSCL 08D

This was a two-year investigation of the Mississippi River discharge processes into the Gulf of Mexico in the vicinity of South and Southwest passes. The river discharge regime was found to follow certain patterns which permitted breaking the study down into three major steps: the river as an estuary; the river discharge as a jet and the turbulent mixing of the discharge with more dense ocean waters offshore. This work was conducted in support of NASA requirements to evaluate the use of remote sensors for the conduct of oceanographic studies from spacecraft. Aircraft mounted sensors were used in this investigation and valuable insight was gained into their potential for oceanography.
Author (TAB)

N70-18434*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MINERALOGY AND PETROLOGY OF THE APOLLO 11 LUNAR SAMPLE

J. A. Wood, U. B. Marvin, B. N. Powell, and J. S. Dickey, Jr. 9 Jan. 1970 115 p refs
(Contract NAS9-8106)
(NASA-CR-107932; SAO-Special-Rept-307) Avail: CFSTI CSCL 08G

Thin sections of 1676 rock fragments (diameter range 1 to 5 mm) from the Apollo 11 bulk sample were studied. In almost all cases, the rocks are fine-grained enough for fragments of this size to constitute representative samples. The following proportions of rock types were found: soil breccias, 52.4%; basalts, 37.4%; glasses, 5.1%; anorthositic rocks, 3.6%; others (including less than 0.1% recognizable meteoritic debris), 1.5%. The basalts consist largely of pyroxene, plagioclase feldspar, and ilmenite. The glasses are impact-melted and range from deeply colored to colorless; from clear and uniform to swirly, vesicular, and heterogeneous. The soil breccia is a consolidated mixture of mineral, rock, and glass fragments in a fine-grained, dark matrix. Overall composition of the breccias is essentially the same as that of the basalts. Only the 61 anorthosite fragments found were totally unexpected. These are light in color, low in density, and range from true anorthosites to anorthositic gabbros.
Author

N70-18439# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

GLOBAL ELECTRICAL CURRENTS

Willis L. Webb Oct. 1969 43 p refs
(AD-697105; ECOM-5271) Avail: CFSTI CSCL 4/1

The atmospheric electrical structure of the earth is postulated to be controlled by a motivating force in the lower ionosphere which is produced by interaction between neutral atmosphere tidal circulations and the ionospheric plasma in the presence of the earths magnetic field. Associated electric fields power the dynamo currents through the Hall effect with a resulting development of a gross electric potential distribution in the lower ionosphere. Asymmetries in these hemispheric potential distributions result in exospheric current flows in low L-shells, and larger differences in potential produced by dynamo return current flows in high magnetic latitudes result in strong currents through high L-shells between auroral zones. Vertical thunderstorm currents with their associated lightning discharges effectively connect the earth to a low potential region of the dynamo circuit and thus supply the earth with an average negative charge which motivates a leakage tropospheric electrical circuit.
Author (TAB)

N70-18442# Army Foreign Science and Technology Center, Washington, D.C.

EFFECT OF THE STRATOSPHERIC TEMPERATURE ON THE ALTITUDE OF RADIOSONDES

A. A. Unukova et al 21 Oct. 1969 11 p refs Transl. into ENGLISH from Gidrometeorologicheskii Nauchn. -Issled. Tsentr. SSSR, Tr., (USSR), no. 26, 1968 p 72-78
(AD-696193; FSTC-HT-23-712-69) Avail: CFSTI CSCL 4/2

Meteorologists are faced with the problem of working out the numerical forecasting of the geopotential of the 100, 50, 30, 20 mb isobaric surfaces, as well as forecasting of wind, temperature, and turbulence at these levels 12-24 hours in advance of the period of radiosonding in the Soviet Union. The solution of these problems can be achieved only through the objective analysis of the field of the geopotential and temperature at the higher levels, and consequently, through the regular reception of observations from all specified altitudes. The deployment of radiosonde capsules in the northwestern and eastern regions of the USSR should vary. The most expensive elastic capsules should be used primarily in the northwestern regions of the USSR.
Author (TAB)

N70-18458# Woods Hole Oceanographic Institution, Mass.

BASIC ENVIRONMENTAL MEASUREMENTS IN A BROAD OCEAN AREA BETWEEN BERMUDA AND THE ANTILLES Final Report, 1 Mar. 1969-30 Jun. 1969

John C. Beckerle 30 Jun. 1969 24 p refs
(Contract Nonr-2866(00))
(AD-696537; WHOI-REF-69-51) Avail: CFSTI CSCL 8/10

The Contract was initiated as a project to provide basic environmental measurements in a broad ocean area between Bermuda and the Antilles that would limit the specifications and the performance of a large long range underwater acoustics system known as Project ARTEMIS. From the beginning in late 1958 until the present the research program included sound transmission

studies, temperature and sound velocity measurements, studies of currents in the deep ocean and studies of the bottom conditions. This program of research has brought about better understanding of the ocean bottom in the Bermuda-Antilles area. A reliable environmental ocean measuring system was developed under this contract and put to use to determine spatial and temporal variations in the acoustic structure in the ocean. Author (TAB)

N70-18469# Army Foreign Science and Technology Center, Washington, D.C.

DECODING AERIAL PHOTOGRAPHS OF GLACIAL LANDSCAPES: INDICATORS OF GROUND WATERS

G. Ya. Meer et al 7 Oct. 1969 33 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Lab. Aerometodov Primenenie Aerometodov Dlia Izuch. Gruntovykh Vod (USSR), 1962 p 69-79
(AD-696181; FSTC-HT-23-398-68) Avail: CFSTI CSCL 8/8

Characteristics of landscape indicators of ground waters are described for the following: four glacial types of landscape, including hilly-moraine, drumlin, morainic plain and terminal-moraine; three water-glacial types of landscape, including kame (and os), lake-glacial plain and outwash plain; the karst erosion type of landscape; and seashores. The decoding of these types of terrain on aerial photographs is discussed. Author (TAB)

N70-18524# Ohio State Univ., Columbus. Dept. of Geodetic Science.

INVESTIGATION RELATED TO THE ESTABLISHMENT OF A WORLD GEODETIC SYSTEM Final Report

John Badekas Jun. 1969 194 p refs
(Contract DAAK02-67-C-0535)
(AD-697163; DGS-124) Avail: CFSTI CSCL 8/5

A world-wide geodetic system which will best serve the present needs of geodesy is defined by four groups of components. These are geocentric coordinates and associate variances of physical points, spherical harmonic coefficients of the geopotential, a mean earth ellipsoid, and a group of seven transformation parameters for each datum which connect the geocentric coordinates with the geodetic coordinates of that datum. The method of determination of that system is given, based on all types of presently available geodetic observations, namely, terrestrial triangulation, astronomic observations, terrestrial gravity observations, and geometric and dynamic satellite observations. For all these observations, proper mathematical models are given. In addition, all the constraints which will guarantee a unique mean earth ellipsoid are introduced. Using the specified geodetic observations in the mathematical models developed, groups of observation equations and then normal equations may be formed. The solution for the components of the world geodetic system will be the solution of the summation of these normals, properly scaled to account for different model or weighting errors in each group. Finally, the contribution of each type of data to the determination of the components of the world geodetic system as well as the overall accuracy achieved is investigated. Author (TAB)

N70-18525# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

THE FREEZING PROCESS AND MECHANICS OF FROZEN GROUND

Ronald F. Scott Oct. 1969 75 p refs *Its* Cold Reg. Sci. and Eng. Monograph 2, Sect. D1
(AD-697138; CRREL-CRSE-2-D1) Avail: CFSTI CSCL 8/13

An outline is given two current theories on the freezing of water in soils. The classification and description, standardized in the United States and Canada, of frozen soils, leads to some laboratory data on the mechanical behavior of frozen soils. The monograph concludes with the application of linear viscoelastic theory to typical field problems. Author (TAB)

N70-18563# Army Foreign Science and Technology Center, Washington, D.C.

CRITICAL ANALYSIS OF AIR TEMPERATURE DATA USING THE ELECTRONIC COMPUTER URAL-4

T. P. Svetlova 3 Nov. 1969 18 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 230, 1968 p 8-18
(AD-697323; FSTC-HT-23-005-70) Avail: CFSTI CSCL 14/2

The paper claims that an analysis of air temperature data depends a great deal on the arrangement of the observation stations, especially the so-called effective stations. The data provided by the peripheral or regional stations do not enhance the accuracy of the analysis. Interpolation discrepancies can be reduced by an optimal selection of effective stations. An optimal interpolation reveals no marked advantage over a linear interpolation, and a critical analysis of average monthly temperature data with the use of computer is said to be feasible. Author (TAB)

N70-18568 National Lending Library for Science and Technology, Boston Spa (England).

EFFECT OF SLOPE PROPERTIES ON THE QUANTITATIVE DISTRIBUTION OF DIRECT SOLAR RADIATION

I. Meszaros et al 20 Jul. 1969 20 p refs Transl. into ENGLISH from Magy. Tud. Akad. Foeld Kut., Foeld Ert. (Hungarian), no. 17, 1968 p 249-256
(NLL-M-7788-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Formulas are summarized for calculating and mapping the distribution of energy derived from direct solar radiation for surfaces of any inclination and exposure. Qualitative results are mentioned for observations on the effects of direct radiation due to slopes on Hungarian plant and crop growth. Author

N70-18578*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.

ADEQUACY OF THE PASSIVE INFLATED FALLING SPHERE TECHNIQUE

K. D. Mc Watters and J. W. Peterson *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 145-164 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 04A

The radar-tracked, inflated, falling sphere is an economical technique for obtaining high-altitude density data at any launch site possessing a high-powered radar. The technique as utilized by many experimenters has provided a large amount of grossly adequate density and temperature data in the stratosphere, mesosphere, and lower thermosphere. In addition, winds are very accurately measured to 70-km altitude. There are several sources of error inherent in the technique, and a general agreement on their magnitudes has yet to be reached. However, recent experiments and studies have been undertaken specifically to ascertain errors. In particular the following areas were examined: detection of sphere deflation, consequences of premature deflation, radar tracking errors, drag coefficients, and methods of data reduction. Author

N70-18585*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

METEOROLOGICAL DATA FROM FALLING SPHERE TECHNIQUE COMPARED WITH DATA FROM OTHER SOUNDING METHODS

Wendell S. Smith *In its* Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 293-300 ref (See N70-18570 07-01)
Avail: CFSTI CSCL 04A

Approximately 50 soundings per year are made of the stratosphere, mesosphere and lower thermosphere utilizing primarily rocket grenade and pitot-tube experiments. It has been recognized that the falling sphere technique offers some potential advantage over these other techniques in terms of economy and operational flexibility provided that the basic accuracy of the sphere technique can be established and maintained. Opportunities to obtain comparative data have been sought, most recently utilizing a sphere which is deployed from a pod mounted to the tail-fin assembly of

a Nike Cajun or Nike Apache rocket carrying either a grenade or pitot-tube experiment. The experiments conducted thus far indicate an average density difference of 3 percent above 70 km where the fall rate of the sphere is supersonic and 8 percent below 70 km where the fall rate is subsonic. The difference above 70 km would appear to be largely random (though the sample is smaller) while below 70 km the sphere yields results which are consistently closer to the standard atmosphere than the results of either the grenade or the pitot-tube experiments. Author

N70-18652# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
THE VERTICAL DISTRIBUTION OF PARTICULATE MATTER NEAR THE SURFACE OF THE EARTH
James M. Rosen Oct. 1969 15 p refs Submitted for publication
(Contract N00014-67-A-0113-0004)
(AD-696541; AP-29) Avail: CFSTI CSCL 13/2

The vertical distribution of particulate matter near Minneapolis and Panama is reported and the influence of temperature, relative humidity and wind velocity on the dust concentration is discussed. Author (TAB)

N70-18757*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.
RELICT DIAGENETIC TEXTURES AND STRUCTURES IN REGIONAL METAMORPHIC ROCKS, NORTHERN MICHIGAN (NASA GEOLOGICAL TEST SITE NUMBER 126)
Christopher Mc A. Powell 25 Jan. 1970 36 p refs
(Grant NGR-14-007-027)
(NASA-CR-104209; Rept-20) Avail: CFSTI CSCL 08G

Relict diagenetic textures and structures in the Siamo Slate of Northern Michigan are preserved in regionally metamorphosed rocks along the northern flank of the Marquette Synclinorium. Essentially nonmetamorphosed, folded argillites and graywackes near Negaunee have a steeply inclined slaty cleavage produced by tectonic dewatering. The cleavage is defined by thin (0.01 mm) foliae of well-oriented phyllosilicates which separate thicker quartz-rich lenses in which phyllosilicates are more randomly oriented. In places, the layering produced by the cleavage foliae is accentuated owing to reconstitution of the intrafolial phyllosilicates and to migration of silica into the interfolial lenses where it forms quartz overgrowths. Rounded detrital quartz grains are distinguished from optically-continuous quartz overgrowths by fluid inclusions, iron-oxide dust, and minute sericite crystals. Author

N70-18804# Minnesota Univ., Minneapolis. School of Physics and Astronomy.
THE USE OF EXTINCTION FROM HIGH ALTITUDE BALLOONS AS A PROBE OF THE ATMOSPHERIC AEROSOLS
T. J. Pepin 13 Nov. 1969 46 p
(Contract N00014-67-A-0113-0004)
(AD-696527; AP-31) Avail: CFSTI CSCL 4/1

A simple instrument is described that measures the intensity of solar radiation in four spectral regions. Instruments of this type have been used to observe the atmospheric extinction from high altitude balloons at sunrise since mid 1965. The data from these balloon flights are described and the vertical profiles of atmospheric aerosols determined from these measurements are presented. Evidence is given for the time variation of aerosols at high altitude. Author (TAB)

N70-18807 Utah Univ., Salt Lake City.
GRAVITY AND MAGNETIC SURVEYS OF THE GROUSSE CREEK MOUNTAINS AND THE RAFT RIVER MOUNTAINS AREA AND VICINITY, UTAH AND IDAHO
Mohamed Mamdouh M. Khattab (Ph.D. Thesis) 1969 368 p
Avail: Univ. Microfilms: HC $16.65/Microfilm $4.60 Order No. 69-6012

Gravity and magnetic surveys were conducted in northwestern Utah and parts of southeastern Idaho during 1967. A total of 320 gravity stations and 402 magnetic stations were occupied. The complete Bouguer values of a total of 625 previously taken gravity stations (Cook and others, 1964) were incorporated in this investigation. The gravity and magnetic data were reduced in the conventional manner using a digital computer. The possibility of overthrusting in northwestern Utah, and decollement thrusting in eastern Nevada and northwestern Utah are studied. A dimensional least-square computer program was used for the computation of a series of polynomial regional surfaces, that uniquely fit the observed data, and a corresponding series of residual maps were also computed. Talwanimass modeling two-dimensional technique was applied to gravity profiles, using a computer program written for the UNIVAC-1108. Dissert. Abstr.

N70-18844# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
OBSERVED VARIATIONS IN SATELLITE SCINTILLATIONS WITH SOURCE ZENITH ANGLE AND AZIMUTH
D. G. Singleton Sep. 1969 17 p refs
(WRE-TN-HSA-156) Avail: CFSTI

An analysis of experimental data is made to determine the nature of the variation of scintillation index with the zenith angle and azimuth of the direction of propagation at an observing point on the earth's surface. Scintillation observations of the Beacon Explorer satellites are employed which were made at a number of sites throughout Australasia ranging in geomagnetic latitude from 25 deg to 50 deg south. At all sites strong evidence is found for the existence of field-aligned columns and indeed, such irregularities appear to be the main cause of scintillations throughout the latitude range regardless of season or time of day. At the high and low latitude stations, some of the field-aligned columns show signs of being spread laterally in a direction a little to the east of magnetic north in all seasons. In the middle latitudes this effect is present only in the summer and the equinoxes. During the winter at these latitudes evidence for the existence of field-aligned sheets of large east-west extent is found. Author

N70-18847*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH RELATED TO MEASUREMENTS OF ATOMIC SPECIES IN THE EARTH'S UPPER ATMOSPHERE Quarterly Status Report
Bernard J. Wood 1 Dec. 1969 10 p refs
(Contract NASr-49(30); SRI Proj. 6682)
(NASA-CR-108125; QSR-10) Avail: CFSTI CSCL 04A

The objective is to elucidate the kinetics and mechanisms of interaction of oxygen atoms with solid surfaces of engineering interest under conditions similar to those encountered in the upper atmosphere. Such information will contribute to the quantitative interpretation of atomic oxygen composition data reported by mass spectrometers in flight. A reaction vessel is employed in which the total gas pressure and the entering flux of oxygen atoms are held constant. The rate of interaction of oxygen atoms with a metal surface is evaluated by observing the diminution in atom flux at the outlet of the vessel when a specimen of the material of interest is inserted into the reactor. Stainless steel specimens were examined and it is apparant that they are efficient sinks for atomic oxygen relative to the noble metals, gold and silver, and to preoxidized titanium irrespective of annealing temperature. Evidence from both flight and laboratory data, indicate that chemical reaction with carbon in some form on the surface may be a significant pathway for oxygen atom removal by stainless steel. The nature of the interaction is important because the appearance of CO2 may be the direct product of an oxygen atom-surface reaction in which case the magnitude of the CO2 signal would provide a basis for correcting the atomic oyxgen signal for surface loss. Author

N70-18856# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
A RELATIONSHIP BETWEEN E SUB s AND EARTH'S MAGNETIC FIELD AT MIDDLE LATITUDES
G. L. Goodwin Aug. 1969 13 p refs
(WRE-TN-HSA-154) Avail: CFSTI

Ionograms and magnetograms recorded at temperate southern latitudes in Adelaide and Woomera were analysed and compared with published data. It is concluded that changes in the intensity of E sub s echoes and in the horizontal component (H) of the geomagnetic field (a) are positively correlated at night in spring and summer months, and (b) during daytime have a positive correlation in mid-spring which changes through late spring to a negative correlation in summer. At times of negative correlation the magnitude of a change in H corresponding to a given change in F sub b E sub s, tended to be larger than at times of positive correlation. The observations are interpreted in terms of current theories of E sub s production. Author

N70-18992# National Research Council of Canada, Ottawa (Ontario). Space Research Facilities Branch.
BIBLIOGRAPHY: SCIENTIFIC PAPERS RESULTING FROM THE CANADIAN UPPER ATMOSPHERE RESEARCH PROGRAM 1965 - 1969
William H. Waters Jan. 1970 42 p refs
(SRFB-037) Avail: CFSTI

The topics covered include the following: balloon, rocket, and satellite soundings; geomagnetic micropulsations; ionospheric electron density, composition, and topside data; radio propagation; aurora data; infrared spectra; OH emissions; and instrumentation. N.E.N.

N70-19135# International Geophysical Year World Data Center A, Washington, D.C.
GRAVITY, TSUNAMI, SEISMOLOGY, LONGITUDE AND LATITUDE, METEOROLOGY. CATALOGUE OF DATA 1 JULY 1957 - 31 DECEMBER 1968
Mar. 1969 63 p
Avail: Issuing Activity

Tabulations of data are presented on gravity, tsunami, seismology, and longitude and latitude observations from 1 July 1957 to 31 December 1968. Abbreviated IGY/IGC meteorological and nuclear radiation data for the period from July 1957 to December 1959 are also given. D.L.G.

N70-19272*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LONGITUDINAL AND LATERAL SPECTRA OF TURBULENCE IN THE ATMOSPHERIC BOUNDARY LAYER
George H. Fichtl and George E. McVehil (Cornell Aeronaut. Lab., Inc.) Washington Feb. 1970 50 p refs
(NASA-TN-D-5584) Avail: CFSTI CSCL 04A

An engineering spectral model of turbulence is developed with horizontal wind observations obtained at the NASA 150 meter meteorological tower at Cape Kennedy, Florida. Spectra, measured at six levels, are collapsed at each level with Monin coordinates, where the longitudinal or lateral spectral energy density, the surface friction velocity, and the mean wind speed at some height are represented. A vertical collapse of the dimensionless spectra is produced by assuming they are shape invariant in the vertical. An analysis of the logarithmic spectrum in the inertial subrange, at the 18 meter level, implies that the local mechanical and buoyant production rates of turbulent kinetic energy are balanced by the local dissipation and energy flux divergence, respectively. Author

N70-19274*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAGNETIC FIELD FLUCTUATIONS IN THE EARTH'S MAGNETOSHEATH
Donald H. Fairfield and Norman F. Ness Jan. 1970 27 p refs Submitted for publication
(NASA-TM-X-63825; X-692-70-20) Avail: CFSTI CSCL 04A

IMP 4 measurements have been used to study magnetic field fluctuations in the sunward hemisphere of the magnetosheath. Power spectra have been computed in the frequency range below 0.2 Hz in a field-aligned coordinate system which allows the separation of transverse and longitudinal perturbations. Power levels on different passes through the magnetosheath typically vary by an order of magnitude or more and spectral peaks are frequently seen throughout the frequency range studied. Spatial variations of wave amplitudes are characterized by enhancements of the transverse mode near both the shock and the magnetopause but these variations tend to be smaller than the day to day variations. On three unique orbits when the bow shock was located more than 9 R(E) outside its average location the magnetosheath power levels were depressed by more than an order of magnitude below their normal lowest levels. Transverse fluctuations were dominant at these times. A weak positive correlation was found between magnetosheath fluctuations and geomagnetic activity. Author

N70-19313*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COORDINATE TRANSFORMATIONS USED IN OGO SATELLITE DATA ANALYSIS
Jan. 1970 15 p
(NASA-TM-X-63826; X-645-70-29) Avail: CFSTI CSCL 08E

Graphical presentations are shown for: (1) geocentrical celestial inertial coordinates; (2) geographic distance coordinates; (3) topographic coordinates; (4) geomagnetic coordinates; (5) solar geomagnetic coordinates; (6) solar magnetospheric coordinates; and (7) solar ecliptic coordinates. Matrices for coordinate transformations from the geocentric celestial inertial coordinate system to other coordinates are developed and a vector expression by magnitude and two angles with respect to the solar ecliptic coordinate system is formed. G.G.

N70-19360# Hawaii Inst. of Geophysics, Honolulu.
INITIAL ADJUSTMENT OF DATA IN THE TROPICS
Takio Murakami Nov. 1969 56 p refs
(Contract ESSA-E-106-69(N))
(HIG-69-23) Avail: Issuing Activity

A simple linearized system in an adiabatic atmosphere, where potential temperature is constant, is used to investigate the initial value problem in the tropics. In the linear system it is possible to assign an exact definition of initial divergence and vorticity such that only Rossby waves are present initially, and gravity waves are completely eliminated. Kinematics of the Rossby waves thus obtained are examined. An attempt is then made to introduce reasonable initial conditions so that they can be applied even when the equations of motion are not linearized. Author

N70-19370# Columbia Univ., Palisades, N.Y. Lamont-Doherty Geological Observatory.
THE BEHAVIOR OF RADIO-CARBON IN SURFACE WATERS OF THE GREAT BASIN
David L. Thurber and Wallace S. Broecker 30 Sep. 1969 40 p refs Presented at the Nobel Symp., Uppsala, Sweden
(CU-2493-10-APP-A; Conf-690817-2) Avail: CFSTI

The exchange rate of carbon dioxide between the atmosphere and water affects the concentration of radiocarbon in solution in surface waters. Three approaches to the problem of carbon dioxide exchange are discussed, including a model for gas exchange, laboratory studies, and the measurement of exchange rates in natural systems. The Great Basin lakes include Great Salt Lake, Pyramid Lake, Mono Lake, and Walker Lake. The non-steady state approach used to study the lakes allowed not only an estimate of the exchange rate of carbon dioxide across the surface of the lake, but gave insight into the relative hydrologic contributions to the lakes. Since exchange of CO2 across the lake surface is an important source of C-14, it should be possible to estimate, from the morphology of the lake basin and from the characteristics of the probable hydrological sources, what the minimum C-14/C-12 will be. Author (NSA)

N70-19371# Dartmouth Coll., Hanover, N.H. Dept. of Earth Sciences.
RADIATION DOSIMETRY, CORRELATION, AND DATING OF CALCAREOUS DEEP-SEA CORES Final Report
Noye M. Johnson 15 Feb. 1969 103 p refs
(Contract AT(30-1)-3860)
(NYO-3860-2) Avail: CFSTI

Two studies performed to evaluate thermoluminescence dosimetry in pelagic sediments as related to geologic age and radioactivity are presented. Dosimetry values and alpha activities were measured at intervals along cores of foraminiferal lutite which collectively represented a complete stratigraphic section of the late Pleistocene. The mineralogy and concentrations of some trace elements in the cores were also determined, and their effects on the natural thermoluminescence were analyzed. The results showed a systematic increase of thermoluminescence dose equivalence and a systematic decrease of radioactivity with depth which is consistent with certain theoretical considerations. A model is suggested which relates measured alpha activities with dose equivalence. The ideal trend of increasing dose equivalence predicted by this model agrees well with experimental results in most cases. In general, relative age relationships may be obtained within and between cores by this method. Author (NSA)

N70-19380# Environmental Research Corp., Alexandria, Va.
PREDICTIONS OF SEISMIC MOTION AND CLOSE-IN EFFECTS: RULISON EVENT
B. G. Weetman, R. H. Berry, L. L. Davis, P. P. de Caprariis, W. W. Hays et al Aug. 1969 70 p refs
(Contract AT(29-2)-1163)
(NVO-1163-180; PNE-R-5) Avail: CFSTI

The development of methods for predicting seismic motion and close in effects for the Rulison event are discussed, with emphasis on: predictions of peak particle motion for selected locations; predictions of distances to peak particle motions of 0.1 g and 0.001 g (accelerations); predicted pseudo-relative velocity spectra at selected stations; geologic environment; predictions of cavity, cracking and gamma-radioactivity radii; and predictions of chimney height and surface spalling. Author (NSA)

N70-19384# New Hampshire Univ., Durham. Physics Dept.
LARGE-AMPLITUDE HYDROMAGNETIC WAVES IN THE INNER MAGNETOSHEATH
Richard L. Kaufmann, Jiann-Tsorng Horng, and Allan Wolfe Feb. 1970 33 p refs
(Grants NSF GA-1131; NSF GA-14954)
(UNH-70-01) Avail: Issuing Activity

Slow magnetoacoustic waves produce the largest amplitude magnetic field perturbations in the 0.01 to 0.1 Hz frequency range within the highly disturbed magnetosheath. The frequencies quoted are frequencies seen by the satellite. Rotational Alfven waves with periods of several minutes and longer are also detected on most orbits. The power spectrum of rotational waves usually rises much more steeply below 0.01 Hz than the power spectrum of magnetoacoustic waves. It is concluded that the magnetoacoustic waves must be produced or strongly amplified at the earth's bow shock or in the outer magnetosheath. The observed rotational waves could be produced beyond the bow shock and carried into the magnetosheath by the solar wind. Author

N70-19410# California Univ., Livermore. Lawrence Radiation Lab.
SIMPLE ANALYTICAL MODEL FOR THE DUST DEVIL
Samuel E. Logan May 1969 28 p refs Sponsored by AEC
(UCRL-50667) Avail: CFSTI

A simple analytical model was developed for prescribing the velocity fields in a dust devil, a small vortex phenomenon common in arid regions. The proposed model has a viscous inner region (boundary layer) composed of a Prandtl layer and an Ekman inflow layer and an inviscid outer region of cyclostrophic balance. Observations indicated that to a good approximation the outer flow is a Rankine combined vortex. Linearization of the equation of motion allows a solution for the radial and tangential velocities in the boundary layer and for the depth of the layer in terms of two parameters obtainable from the observations: alpha(r), the inflow angle at the top of the Prandtl layer; and eta(r), a modified Ekman length determined by the outer flow. The vertical velocity field is then found by application of the continuity equation. The velocity fields were found to resemble a first order solution by Kuo for convective atmospheric vortices, and compare reasonably with the measurements of Sinclair. Author (NSA)

N70-19562# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
CONSIDERING THE FLOW OF DETRITUS ALONG THE SHORELINE WHEN CALCULATING THE ALTERATION OF RESERVOIR SHORES
B. A. Pyshkin *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 11-15 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

A method is worked out for predicting the alteration of sea coasts and reservoir shores on the basis of detritus flowing along the shoreline due to oblique wave action toward the shore. The method for calculating the extent of shoreline deformation takes into account the three-dimensional problem and is based on an equation for the amount of detritus. Transl. by R.B.

N70-19553# Kiev Univ. (USSR).
PREDICTING THE FINAL ALTERATION OF RESERVOIR SHORELINES TAKING THE THREE-DIMENSIONAL PROBLEM INTO ACCOUNT USING THE KIEV RESERVOIR AS AN EXAMPLE
S. N. Lisogor *In* Akad. Nauk URSR Dyn. of Circulating and Wave Flows, Issue 3 1968 p 16-23 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

The results of solving the two- and three-dimensional problems are compared for predicting the alteration of a section of the right bank of the Kiev reservoir. The problems are solved by the equation for the amount of detritus flowing along the shoreline of the reservoir. Transl. by R.B.

N70-19554# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
PREDICTING THE ALTERATION OF THE KIEV RESERVOIR SHORELINE
V. V. Khomitskiy *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 24-29 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

As the main source of energy which generates wave action, the wind indirectly affects shoreline alteration and the processes which determine the movement of detritus along the shoreline. Based on the solution of the two-dimensional problem by three methods, the values for the alteration of the right bank of the Kiev reservoir due to wind-induced wave action are compared and the expected magnitude of shoreline deformation is given. Transl. by H.W.

N70-19555# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
STUDYING THE DYNAMIC EQUILIBRIUM PROFILE OF THE BANKS OF LARGE IRRIGATION CANALS
V. L. Maksimchuk *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 30-36 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

A theoretical formula is presented which describes the dynamic equilibrium profile of canal banks better than existing empirical formulas. It is shown that when the waves approach in an oblique direction, the profile will be more abrupt than in the case of frontal wave action. A method developed previously for modeling the shoreline zone of reservoirs affected by wave activity is confirmed. Transl. by H.W.

N70-19556# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
CALCULATING THE DEVELOPMENT TIME OF BAYS WHEN THE SHORELINE IS PROTECTED BY A DISCONTINUOUS BREAKWATER
Yu. N. Sokolnikov *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 37-42 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Based on the criterion equations for the surface areas of eroded bays formed when the shorelines are protected by discontinuous breakwaters, an expression is derived for the time scale. A method is developed for calculating the development time of wave-eroded bays during experimental study of the problem. Transl. by H.W.

N70-19559# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
THE LENGTH OF THE TRANSITION ZONE ON THE OUTER EDGE OF A SHORELINE SLOPE CONSISTING OF NONADHESIVE SOILS
Ye. S. Tsaytts *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 54-57 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

The length of the transition zone is calculated from the wave parameters, the water depth in front of the slope, and the angle of internal friction of the soil. Studies of slopes made up of eroded soils show that the horizontal magnitude of accumulative deposits should be greater when the water depth in front of the slope is less. Experiments show that the horizontal magnitude in the upper part of the accumulative zone increases with wave length, and it is assumed in deriving the calculating formula that the length of the transition zone is proportional to the wave length and inversely proportional to the water depth in front of the slope.
Transl. by R.B.

N70-19560# Akademiya Nauk URSR, Kiev.
CALCULATING THE STABILITY OF BREAKWATER SLOPES MADE UP OF ROCK DEBRIS
A. V. Mishin (Min. of Munic. Econ.) *In its* Dyn. of Circulating and Wave Flow, Issue 3 1968 p 58-60 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

A simplified formula is derived for calculating the individual weight of rocks which are stable in the pre-erosion zone of breakwaters as a function of wave height and length, the total weight of the rocks and water, the incline of the slope, and the shape factor of the rocks. An example is given for determining the weight of a stable mass in the pre-erosion zone of a slope affected by wave action.
Transl. by R.B.

N70-19563# Akademiya Nauk URSR, Kiev.
THE DEVELOPMENT OF ACCUMULATIVE SHAPES IN RESERVOIR BAYS
I. G. Kondratyev (Volga Basin Admin. of Waterways, Saratov) *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 75-81 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Problems are discussed for accumulation of detritus in the mouths of bays and inlets of reservoirs which inhibit shipping. The mechanism of the change in the shape of bays and inlets due to current-borne debris is described. The amount of excavation required to keep the waterways open is tabulated.
Transl. by R.B.

N70-19565# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
PLANNING TECHNICAL SPECIFICATIONS AND DESIGN STANDARDS FOR DISCONTINUOUS BREAKWATERS
Yu. N. Sokolnikov *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 93-107 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Functions are derived and the order for their use denoted when designing discontinuous breakwaters to protect shorelines altered by wave action. The optimum designs and applications of discontinuous breakwaters, bulkheads, and discontinuous jetties are discussed.
Transl. by R.B.

N70-19566# Akademiya Nauk URSR, Kiev. Inst. Gidromekhaniki.
VARIATIONS IN THE ROLL HEIGHT OF A WAVE ONTO A CONCRETE EMBANKMENT
Ye. S. Tsaytts and V. V. Khomitskiy *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 108-114 refs In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

The basic characteristics for the static distribution of roll height of waves onto concrete embankments are explained and their relationship to the height characteristics of wind-induced waves are discussed. The results of calculating roll height by derived formulas are compared with data from full-scale observations.
Transl. by R.B.

N70-19567# Akademiya Nauk URSR, Kiev.
THE PROBLEM OF STUDYING THE SEDIMENTATION OF SILT DEPOSITS
A. V. Mishin (Min. of Munic. Econ.) *In its* Dyn. of Circulating and Wave Flows, Issue 3 1968 p 115-122 In RUSSIAN (See N70-19551 07-12)
Avail: CFSTI

Experimental studies show that the molecular shell formed around silt particles appreciably affects their hydraulic size. Generalizations and analyses are given for calculating the factors which determine particle size and rate of sedimentation.
Transl. by R.B.

N70-19622# Alaska Univ., College. Geophysical Inst.
A STUDY OF MAGNETOSPHERIC SUBSTORMS IN CONJUNCTION WITH THE VELA SATELLITE DATA Annual Progress Report
S. I. Akasofu Sep. 1969 48 p refs
(Contract AT(45-1)-2096)
(RLO-2096-1) Avail: CFSTI

Detailed data are given and discussed for the following geomagnetic events: (1) Sept. 19, 1965; (2) Oct. 24, 1965; (3) Oct. 25, 1965; (4) Sept. 23, 1965; (5) Oct. 2, 1965; (6) Sept. 28, 1965; and (7) Sept. 24, 1965.
NSA

N70-19663# Environmental Science Services Administration, Oak Ridge, Tenn.
PLUME RISE: A CRITICAL SURVEY
G. A. Briggs 1969 81 p refs Prepared for AEC
(TID-25075) Avail: CFSTI

The mechanism of plume rise and dispersion is described in qualitative terms with emphasis on possible aerodynamic, meteorological, and topographical effects. Plume-rise observations and formulas in the literature are reviewed, and a relatively simple theoretical model is developed and compared with other models. All available data are used to test the formulas for a number of idealized cases. The inverse wind-speed relation is shown to be generally valid for the rise of a hot plume at a fixed distance downwind in near-neutral conditions. Nine formulas of this type are compared with data from sixteen different sources, and the best agreement is obtained, and modified by the assumption that a ceiling height is reached at a distance of ten stack heights downwind. The term F is proportional to the heat emission. In uniform stratification buoyant plumes are seen to follow the 2/3 law until a ceiling height of 2.9 (F/us) cube root is approached, where s is proportional to the potential temperature gradient.
Author (NSA)

N70-19687# California Univ., San Diego. Scripps Inst. of Oceanography.
DIRECTIONAL RADIANCE LUMINANCE OF THE SEA SURFACE

Jacqueline I. Gordon Oct. 1969 57 p refs
(Contract N00024-68-C-1100)
(AD-697268; SIO-REF-69-20) CSCL 8/10

The development of the equations for the computation of directional sea radiance and/or luminance are presented. Three types of conditions for which calculations may be made are each treated separately: first, the radiance or luminance of the calm sea; second, the radiance or luminance of the time- or space-averaged wind-ruffled sea; and third, the radiance or luminance of the sea surface in which large wave pattern is resolved but small capillary waves are unresolved. Author (TAB)

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N70-18316# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
MEASUREMENT OF AIR TEMPERATURE FLUCTUATIONS WITH THERMOCOUPLES
G. S. Campbell Oct. 1969 26 p refs
(AD-697107; ECOM-5273) Avail: CFSTI CSCL 4/2

Equations for determining the radiant heating and time constant of small thermocouples used for air temperature measurement are presented. Calculated and measured values are compared for small diameter copper-constantan thermocouples exposed to direct sunlight. The effects of two types of aspirated thermoshields on temperature fluctuations measured inside the shield with 0.0025 cm thermocouples were determined. Thermoshield design was shown to be critical in temperature fluctuation measurement. Author (TAB)

N70-18349*# National Aeronautics and Space Administration, Washington, D.C.
INFRARED SPECTROSCOPY
K. C. Herr and G. C. Pimentel *In its* Mariner-Mars 1969 1969 p 83-96 refs (See N70-18343 07-31)
Avail: CFSTI CSCL 07D

The infrared spectroscopy experiments of Mariners 6 and 7 obtained spectra of the Mars atmosphere from 1.9 to 14.3 microns in 10-sec. scanning intervals. Most of the spectral features were provided by gaseous CO2; however, solid CO2 absorptions at 3 micron observed over the polar cap edge and dark limb absorptions near 12 micron were indicative of solid CO2 crystals. G.G.

N70-18350*# National Aeronautics and Space Administration, Washington, D.C.
ULTRAVIOLET SPECTROSCOPY
C. A. Barth, W. G. Fastie, C. W. Hord, J. B. Pearce, K. K. Kelly et al *In its* Mariner-Mars 1969 1969 p 97-104 (See N70-18343 07-31)
Avail: CFSTI

Initial analyses of Mariner 6 and 7 spectroscopic measurements on the Martian upper atmosphere indicate the presence of a hydrogen corona extending to about 25 000 km above the Martian surface. This hydrogen is attributed to photodissociation of water vapor. Altitude distribution of upper atmospheric emissions shows the temperature of the Martian exosphere to be less than that of Earth by more than a factor of 2. Observed emissions in the 1900 to 4300 A wavelength range are associated with ionized carbon dioxide and carbon monoxide and clearly indicate the dominance of CO2 with a CO2(+) ionosphere. Comparison of Mariner spectral data on Mars with similar spectral data of the Earth atmosphere establishes the common feature of the 2927 A line of atomic oxygen and the absence of atomic, molecular, and ionized molecular nitrogen emission features. G.G.

N70-18351*# National Aeronautics and Space Administration, Washington, D.C.
INFRARED RADIOMETRY
G. Neugebauer, G. Muench, S. C. Chase, Jr., H. Hatzenbeler, E. Miner et al *In its* Mariner-Mars 1969 1969 p 105-109 refs (See N70-18343 07-31)
Avail: CFSTI CSCL 14B

The infrared radiometry experiment provided data on the composition of the south polar cap as well as temperature fluctuation measurements of the daytime Mars hemisphere. Measurements over the polar cap indicated that the composition of the polar cap is predominantly CO2. Temperature fluctuations detected in the daytime hemisphere corresponded to large-scale variations in the ability of the surface to absorb solar radiation; only fluctuations not correlated to albedo variations were found over chaotic terrain at 2.5 microns. G.G.

N70-18363# Army Foreign Science and Technology Center, Washington, D.C.
STANDARD FOR MEASURING RECEIVERS
24 Oct. 1969 30 p refs Transl. into ENGLISH from a Russian report
(AD-696183; FSTC-HT-23-636-68) Avail: CFSTI CSCL 14/2

Parameters are shown for the three measuring receiver classes. Variance of frequency measurement and impulse signal measurement is discussed. Characteristics of associated devices such as the Standard Signal generator and the Frequency Measuring device are mentioned. Block diagrams are followed in paragraphs on methods of testing, along with instructions on the application of a testing device. Author (TAB)

N70-18408# Naval Weapons Center, China Lake, Calif.
INITIAL REPORT ON EQUIVALENT DAMAGE MEASUREMENT BY USING S/N FATIGUE GAGES
Thomas B. Cost *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 35-40 refs (See N70-18404 07-32)
Avail: CFSTI

The S/N Fatigue Gages ascertain structural degradation induced in missile body structures during road transportation tests and cross country transportation tests. The results indicate a reliable and simplified method for correlating field induced damage to laboratory controlled equivalent damage tests can be developed by utilizing fatigue gages. Author

N70-18409# Navy Underwater Sound Lab., New London, Conn.
HOLOGRAM INTERFEROMETRY AS A PRACTICAL VIBRATION MEASUREMENT TECHNIQUE
Cameron D. Johnson and Gerald M. Moyer *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 41-49 ref (See N70-18404 07-32)
Avail: CFSTI

Hologram interferometry, a technique that has been described primarily in the optical literature, is an eminently practical means of measuring mechanical vibrations. The process uses coherent illumination to produce an optical interference pattern on the surface of a vibrating object. Qualitative and quantitative information is readily obtained from the interference pattern. Unlike conventional interferometry, this technique is simple and straightforward and does not require an optically polished specimen. An example in which hologram interferometry was used to study the vibration behavior of two plate specimens is presented. The mode shapes of 36 discrete resonant modes were photographed and used to draw conclusions concerning boundary conditions, assembly procedures, and material properties. It is concluded that the time has come for mechanical engineers to start taking advantage of this area of optical technology. Author

N70-18411# McDonnell Aircraft Corp., St. Louis, Mo. Engineering Labs.

AUTOMATIC NORMALIZATION OF STRUCTURAL MODE SHAPES

C. C. Isaacson and R. W. Merkel *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 63-69 refs (See N70-18404 07-32)

Avail: CFSTI

Two basic problems are encountered in the measurement and plotting of vibration mode shapes of large structures. Application of hand-held vibration probes to the structure sometimes causes a small amount of damping and may distort the indicated mode shape. Data from each test station must be manually divided by a reference value in order to plot the normalized mode shape. In order to minimize these problems, an instrument, developed and evaluated in the laboratory, is used to normalize data outputs to a reference transducer on the structure, thereby cancelling the small damping effect and providing a normalized ratio indication. The instrument, designed primarily for use during aircraft ground vibration testing, processes output signals from the velocity pickups which are used to map the vibratory mode shapes of the aircraft. Diagrams of the instrument's operational circuits are presented with complementary descriptions of operations including the mathematical computations performed in each module. System evaluation includes an analysis of performance data curves. Author

N70-18449*# Harvard Coll. Observatory, Cambridge, Mass.

HARVARD COLLEGE OSO-IV POINTED EXPERIMENT: AN ANALYSIS OF THE MALFUNCTION DURING ORBIT 637

R. Dower, N. Hazen, and J. Rechavi Feb. 1969 88 p refs

(Contract NASw-184; Proj. Solar Satellite)

(NASA-CR-107953; TR-7) Avail: CFSTI CSCL 14B

The pointed experiment aboard OSO-IV suffered a disabling electronic malfunction after a few weeks of successful scientific operation. Investigations which were undertaken to evaluate the malfunction are described. The initial observations are discussed, and the total available data are then reviewed. This report describes analyses which were undertaken both with the data and with the design information on the instrument. It also includes studies which were performed in the laboratory with the prototype instrument and various subassemblies. Conclusions are drawn which strongly implicate the high voltage power supply, particularly the transformer, as the origin of the malfunction. Recommendations are made on how similar problems might be avoided in the future. Author

N70-18459*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Div.

DEVELOPMENT OF MICROWAVE NDT INSPECTION TECHNIQUES FOR LARGE SOLID PROPELLANT ROCKET MOTORS Final Report

T. E. Eckert and B. L. Lamb 15 Jun. 1969 105 p refs

(Contract NAS7-544)

(NASA-CR-107951; FR-1117) Avail: CFSTI CSCL 14B

This is the technical progress report on work performed for the development of microwave nondestructive testing techniques for large solid-propellant rocket motors. A Frequency Domain Microwave Interferometer was developed. The device is described as a near-field radar with high resolution, or as a standing-wave-ratio and reflectometry instrument capable of separating the reflected signal into components according to the location of the reflector along the line, making it, in effect, a time domain reflectometer for waveguide. The microwave technique was evaluated and successfully demonstrated to detect flaws in full-scale large solid-rocket motor sections, motors, large liquid-rocket, non-metallic nozzle components, and jet-aircraft tires. Experiments include the effect of target geometry, measurements on defect standards and the inspection of full-scale hardware in the range of 12.4 to 40 GHz. Other applications such as material properties determination and microwave component testing are considered. Author

N70-18467# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN INSTRUMENT FOR RECORDING MEASUREMENT RESULTS ON MAGNETIC TAPE

B. A. Lvov 5 Sep. 1969 13 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Sibirskoe Otd. Inst. Avtomatiki i Elektrometrii (Russian), v. 1, 1965 p 158-163

(AD-696299; FTD-HT-23-116-68) Avail: CFSTI CSCL 14/3

The author describes a tape recorder for converting analog signals into digital form, recording them on tape, and using the recorded data as a direct input to a computer for cross-checking purposes. The recorder has two input channels so that two separate processes can be monitored simultaneously. The input voltage in each channel is amplified and converted into a five-bit binary code which corresponds to the 32 discrete levels of the input voltage. The A/D conversion uses a ramp generator, a level comparator and a 150 KHz gated pulse generator. The pulse train, containing a number of pulses corresponding to the sampled amplitude of the input signal (sampling rate of up to 200 per second), is encoded into five-bit words by means of a ring counter. The output is used to modulate the 7.2 KHz carrier driving the magnetic heads. In addition to the signal information, synchronizing pulses are included between each word. The system is described in detail, including a block diagram, waveforms, and performance information. TAB

N70-18478# Massachusetts Univ., Amherst. Polymer Research Inst.

AN APPARATUS FOR INSTANTANEOUSLY MEASURING UV, VISIBLE OR INFRARED DICHROISM FROM THIN POLYMER FILMS DURING HIGH SPEED STRETCHING

Garth L. Wilkes, Daniel A. Keedy, and Richard S. Stein Jun. 1969 25 p refs Sponsored in part by NSF and Gen. Tire and Rubber Co.

(Contract Nonr-3357(01))

(AD-696559; ONR-TR-117) Avail: CFSTI CSCL 14/2

An apparatus has been constructed for following changes in the dichroism of a polymer film undergoing rapid elongation. By means of a rapidly rotating mirror with evenly spaced open sectors, a beam of radiation is passed through the sample and then alternately polarized in the horizontal and vertical direction so that the horizontal and vertical absorbancies may be rapidly compared in times short as compared with the time of sample elongation (a few milliseconds). The apparatus utilizes reflection optics and a grating monochrometer so that measurements may be made using ultraviolet, visible, or infrared radiation. The transmitted intensity is detected by a photomultiplier or semiconductor cell, the output of which is amplified and displayed on an oscilloscope. A temperature controlled sample chamber is provided. The operation of the apparatus is illustrated by following the change in dichroism of a sample of dehydrohalogenated polyvinyl chloride with visible radiation during rapid extension. Author (TAB)

N70-18479# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASURING AVERAGE WIND SPEED

V. Yu. Torochkov et al 2 Sep. 1969 8 p refs Transl. into ENGLISH from Nauch-Issled. Inst. Gidrometerol. Priborostr. (USSR), no. 17, 1967 p 15-18

(AD-696229; FTD-HT-23-341-69) Avail: CFSTI CSCL 4/2

An investigation was made of the transient response of rotating windmill and cup anemometers. In general, the experiments confirmed the contention that rotating anemometers indicate the average wind velocity as being higher or lower than the actual value, depending on the circumstances. The cause for this discrepancy is the difference in the effective aerodynamic moments during the acceleration and the deceleration of the rotor. The comparison of the transient response of cup and windmill anemometers showed that for the latter device the time constant of the transient process approximating the deceleration was four times greater than the

time constant during the acceleration. For the cup anemometer this ratio was one to six. A comparative evaluation of the average wind velocity indication by a rotating cup anemometer using a restrained anemometer as a reference was also made. It was found that the rotating anemometer indicated higher average wind velocity for velocities up to 10-11 m/sec., and lower average wind velocity for higher values. The results of the investigation indicate that true results can be obtained only from a simultaneous study of the wind structure and the dynamic properties of the wind gages. Author (TAB)

N70-18483# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
TRANSMISSION OF SMALL-SIZE DETAILS IN SEQUENTIAL IMAGES [TRANSMISSION DES PETITS DETAILS DANS LE CAS DE REPRODUCTIONS SUCCESSIVES]
I. B. Blyumberg and T. M. Zyazina (Leningrad Inst. of Motion Picture Engr.) [1969] 14 p refs In FRENCH and RUSSIAN
(LRBA-69-0365) Avail: CFSTI

To analyze transmission of small-size details in a complex technological process it is necessary to determine the resolving power of the devices, apparatuses, and photographic materials, and also to calculate the resolving power of the systems. It becomes necessary to determine the resolution of the production equipment, since much data may only be obtained statistically. Known formulas were applied to more complex systems which include the negatives, copying apparatus, photographic materials, objectives, etc. Several of the formulas were compared for values of resolution found by experiment and by calculation, and were then subjected to correlation analysis. The results show that the formula given for complex systems may be used for approximate calculations of the resolving power of motion picture systems. Transl. by R.B.

N70-18554# Army Foreign Science and Technology Center, Washington, D.C.
THE ACTION OF HIGH-POWER LASER RADIATION ON PHOTOGRAPHIC MATERIALS
F. A. Korolev et al 29 Oct. 1969 14 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (USSR), v. 9, no. 2, 1968 p 318-319
(AD-697322; FSTC-HT-23-694-69) Avail: CFSTI CSCL 14/5

The direct dependence of the blackening of photographic film by laser radiation on the energy of the laser radiation has been investigated. Blackening from one laser pulse and from two pulses impinging on the same site on the film were measured. It is concluded that a two-photon mechanism is involved in the blackening phenomenon. Author (TAB)

N70-18573*# Naval Ordnance Lab., White Oak, Md.
RECENT PASSIVE DENSITY SENSOR EFFORT AT THE NAVAL ORDNANCE LABORATORY
George J. Sloan *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 55-64 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 14B

Described is the development of a passive density sphere for atmospheric sounding that can be launched from shipboard antiaircraft systems in dart vehicles. A biconical ram-air inflated balloon evolved as the ideal shape from the evaluation differently constructed inflatable sphere structures. The aerodynamic characteristics of this device include excellent stability properties with no change in drag coefficient at small angles of attack. G.G.

N70-18581*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE TONE RANGE/TELEMETRY INTERFEROMETER TRACKING SYSTEM FOR SUPPORT OF SOUNDING ROCKET PAYLOADS
John I. Hudgins and James R. Lease *In its* Status of Passive Inflatable Falling Sphere-Technol. for Atmospheric Sensing to 100 km 1969 p 187-226 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 14B

This system is comprised of three basic systems: the airborne, the tone range, and the interferometer. The airborne system provides ranging reception and telemetry transmission, the tone range system provides distance or range data, and the interferometer system provides angular data. The tone range system derives range by measuring the phase shift experienced by two tones. These tones are radiated from the ground to the airborne system and reradiated back to the ground by the telemetry transmitter. The tones are then compared in phase with the ground standard. The phase shift of each tone is proportional to twice the slant range to the airborne system. The interferometer system derives angular data by measuring the difference in electrical phase of arriving energy, radiated from the airborne system, at two ground antennas spaced 16 wavelengths apart. Comparing the phase of the outputs of the two antennas, the azimuth of the airborne system can be determined with respect to the antenna base line. This system has been used to track 22 sounding rockets since 1967. Several of these rockets were also tracked by radar and Radint. A comparison of the trajectories has shown that there is an average difference of 30 meters. Author

N70-18586*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THERMAL CONDUCTIVITY, ELECTRICAL RESISTIVITY AND THERMOPOWER OF AEROSPACE ALLOYS FROM 4 TO 300 K
J. G. Hust, Robert L. Powell, and D. H. Weitzel 9 Jun. 1969 198 p refs
(NASA Order-R-06-006-003)
(NASA-CR-108088; NBS-9732) Avail: CFSTI CSCL 14B

An apparatus for the measurement of thermal conductivity, electrical resistivity, and thermopower from 4 to 300 K is described. This apparatus utilizes the steady state, axial heat flow method. The specimens are cylindrical rods about 23 cm long and 0.1 to 1.0 sq cm in cross sectional area. Included is a detailed discussion of the limitations of the apparatus, probable errors, and data analysis methods. Tables and figures of thermal conductivity, electrical resistivity, Lorenz ratio, and absolute thermopowers are presented for titanium alloy A 110-AT, aluminum alloy 7039, Inconel 718, Hastelloy X, reactor grade beryllium, and PO-3 graphite. Extensive raw experimental and computer processed data are also included here to serve as a permanent record. The uncertainty of the property data presented is estimated at 1 to 2% for thermal conductivity, 0.2% for electrical resistivity, and 0.05 microvolts/K for thermopower. Author

N70-18691 National Lending Library for Science and Technology, Boston Spa (England).
THE DVM-3 TWO-BEAM DOUBLE VACUUM MONOCHROMATIC SPECTROSCOPE FOR USE IN THE 100-220 nm SPECTRAL RANGE [DVOINOI DVUKHLUCHEVOI VAKUUMNYI MONOKHROMATOR DVM-3 DLYA OBLASTI SPEKTRA 100-220 nm]
V. Tit Oct. 1969 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz. Mat. (USSR), v. 16, no. 3, 1967 p 393-396
(NLL-RTS-5365) Avail: Natl. Lending Library, Boston Spa, Engl.: 10s or 1 NLL photocopy coupon

Use of ready-made ordinary monochromators in combination to make a double monochromator is described. The principal purpose is to enable radiation absorption in the apparatus to be computed. Author

N70-18761 Virginia Univ., Charlottesville.
SOME USEFUL CONTRIBUTIONS OF THE WAVE FRONT SHEARING AND KOSTERS INTERFEROMETERS TO

ASTRONOMY

Paul Henry Knappenberger, Jr. (Ph.D. Thesis) 1968 82 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-4024

The area of astronomy in which the wave front shearing interferometer finds application is in the evaluation of the optical performance of telescopes. An attempt was made to present the data reduction technique in a simple manner and to compare the WSI test with the accepted standard Hartmann test. A technique for collimating a Cassegrain telescope using the WSI is described and a catalog of interference patterns for various types and amounts of decollimation is included. Application of the Kosters prism to adjustment of optical telescopes is considered. The general conclusions reached were that the Kosters prism is more sensitive to misalignment than the WSI and can be used effectively in the laboratory or above the earth's atmosphere in an earth orbit telescope. The atmospheric turbulence limits the use of the Kosters prism for optical testing and the WSI is to be preferred for tests on earth based instruments. A careful look at the possibility of using the Kosters prism to measure stellar diameters showed that this is a most promising technique. Dissert. Abstr.

N70-18763*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

DESIGN AND DEVELOPMENT OF THE HAZARDOUS GAS DETECTION SYSTEM FOR LAUNCH VEHICLE PROPELLANT LOADING AND CHECKOUT

C. L. Perry, A. C. Krupnick, and R. J. Harwell 3 Apr. 1968 51 p
(NASA-TM-X-53720) Avail: CFSTI CSCL 14B

This report describes the development of an apparatus for remotely monitoring the gas purge environments of the Saturn launch vehicle systems during the prelaunch and checkout period. The apparatus was designed around a remotely controlled mass spectrometer with solenoid-operated sampling valves which allow surveillance of selected areas within the vehicle. The system consists of slightly modified commercial components. The modifications do not destroy normal manual operation capabilities of the equipment. All the versatility of the mass spectrometer is retained for possible use as an analytical mass spectrometer when the system is not being used to support a launch vehicle test. The combination of remote control, long distance operation, and multiple sampling over a long distances is a unique application of the mass spectrometer technique of analysis. Author

N70-18769*# Wyoming Univ., Laramie. Dept. of Physics.

[AN EXPERIMENTAL INVESTIGATION OF HARRINGTON'S THEORY OF INTENSITY MEASUREMENTS] Status Report, 1 Jan. 1967 – Jan. 1969

Edgar A. Rinehart Jan. 1969 24 p refs Revised
(Grant NGR-51-001-020)
(NASA-CR-107171-Rev) Avail: CFSTI CSCL 14B

Experimental verification of the value of Harrison's saturation approach to intensity measurements is described for quantitative analytical microwave spectroscopy. It is shown that the spectrometer signal is a linear function of partial pressure of the absorber over a pressure range above 3.5 m torr for pure gases and that the linear range extends to much lower pressures for gases of higher dilution. Slope ratios as well as signal measurements give accurate partial pressure measurements of individual components in gaseous mixtures at microwave powers below 50 milliwatts during in-line operation of the instrument. G.G.

N70-18771*# International Business Machines Corp., Rockville, Md. Federal Systems Div.

RESEARCH ON MULTIPROCESSING TECHNIQUES FOR MULTIFUNCTIONAL SATELLITES Final Report

Sep. 1969 167 p refs
(Contract NAS12-600)
(NASA-CR-86329) Avail: CFSTI CSCL 14B

The use of a multiprocessor computer configuration for data management, data processing, and spacecraft operations is considered for the Nimbus D mission. Considered are various experiments and operations that could be implemented by the processor in real time during onboard processing. A detailed description of the processors functions includes experiment control, data handling, and spacecraft operations. Flow charts are developed, instructions and data storage requirements are evaluated, and operations/sec. are estimated. The processor also analyzes imagery data and temperature and humidity profiles for inflight calibration and correction procedures. G.G.

N70-18799*# Utah Univ., Salt Lake City. Electrical Engineering Dept.

A DATA REDUCTION PROGRAM FOR A ROCKETSONDE TEMPERATURE SENSOR

Warren W. Lacey and Forrest L. Staffanson Aug. 1969 95 p refs
(Grant NGR-45-003-028)
(NASA-CR-66895; UTEC-MR-69-108) Avail: CFSTI CSCL 14B

A mathematical model for obtaining *air temperature* from a standard ARCASONDE bead, wire film temperature sensor and its radar track is developed in this thesis. In addition, *pressure* and *density* of the atmosphere, and *horizontal winds* are computed. While this model has an unrestricted altitude range, the rocketsonde flights used generally vary from 20 to 90 kilometers. The temperature errors encountered in these flights become large at high altitudes, with aerodynamic heating and thermal conduction being the largest. Aerodynamic heating is due mainly to the high speed of the rocket and the initial altitudes. The thermal conduction model describes a bead and film, which respond with a dynamic lag to temperature changes, connected by a wire which responds instantaneously. The temperature corrections due to radiation and electrical heating are relatively small at altitudes below 50 kilometers. Approximate values of radiation heating in the sensor can be computed from Lambert's Cosine Law. Author

N70-18809# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.

THE MIT VIBRATING STRING SURFACE SHIP GRAVIMETER

Charles G. Wing Sep. 1969 119 p refs
(Contract Nonr-1841(74))
(AD-697315; DSR-75162-1) Avail: CFSTI CSCL 14/2

A surface ship gravimeter is described. The gravimeter is designed for low cost production, yet has been proven accurate to better than 1 mgal at sea. This report contains the information required by a potential system manufacturer or by a competent researcher to duplicate the original gravimeter. Author (TAB)

N70-18829*# Teledyne Systems Co., Northridge, Calif.

A THREE-AXES ANGULAR ACCELEROMETER SYSTEM Final Report

Apr. 1969 53 p
(Contract NAS4-1238)
(NASA-CR-106207) Avail: CFSTI CSCL 14B

This report documents the results of the development and fabrication of two three Axes Angular Accelerometer Systems (3AS) for NASA Flight Research Center, Edwards, California. It includes a brief technical description, electrical schematics, outline and assembly drawings, input-output specifications, test procedures and results, and information required for installation, use and maintenance of the systems. The 3AS senses angular rate inputs about three orthogonal axes and provides an amplified analog dc voltage output which is proportional to the angular acceleration input. Author

N70-18843# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.

A DATA RECORDING AND CONTROL UNIT FOR A

PRESSURE SCANNING SYSTEM
H. R. Naumann Mar. 1969 22 p ref
(WRE-TN-HSA-146) Avail: CFSTI

A pressure recording system incorporating automatic or manual control of a pressure multiplexing valve and high speed printed output was designed and used in wind tunnel experiments. System components and their mode of operation in the complete control loop are described. Special features are that the pressure scanning valve forms part of a closed loop control link, and a mains-synchronised print-rate control enables leak rates of pressure installations to be determined. Performance details of the overall system are discussed. Author

N70-18889*# Oklahoma Univ., Norman. Dept. of Physics and Astronomy.
AN IMPROVED UV INTERFEROMETER
Richard A. Day 15 Jan. 1970 13 p ref
(Grant NGR-37-003-047)
(NASA-CR-108131) Avail: CFSTI CSCL 14B

An interferometer which is suitable for the ultraviolet region of the spectrum is described. This device utilizes the principle of forming its interference pattern from a set of grazing incidence reflections from two plane parallel plates; however, tilting the plates decreases the dephasing problem evidenced in the forerunners. A specific instrumental system which optimizes the interference pattern for lambda = 1000 A is also described. Author

N70-18900*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1969 SUN SENSOR DEVELOPMENT
L. F. Schmidt 1 Jan. 1970 12 p
(Contract NAS7-100)
(NASA-CR-108173; JPL-TR-32-1452) Avail: CFSTI CSCL 14B

The sun sensors are electrooptical devices used in the Mariner Mars 1969 attitude control system. These sensors provide two axis error signals for turning the spacecraft toward the sun, such that the solar panels are illuminated. The sun sensors also provide continuous error signals for holding this position throughout the mission. A special sensor, the sun gate, provides an indication of whether the spacecraft is aligned to the sun within 4.5 degrees of true position in both axes. The operation of the sensors is described as well as the design, testing, and problems encountered. Author

N70-18959*# California Inst. of Tech., Pasadena.
A SIMPLE, VERSATILE THERMOSTAT FOR SMALL OBJECTS AND THE TEMPERATURE RANGE OF 100 K TO 400 K Interim Scientific Report
Marc-A. Nicolet 29 Aug. 1969 38 p refs
(Grant NGR-05-002-100)
(NASA-CR-86330) Avail: CFSTI CSCL 13A

The thermostat was designed to meet the following specifications: (1) temperatures ranging from about 100 K to 400 K, (2) a stability and an absolute error of less than or equal to 1 K, (3) the ability to easily set and rapidly acquire less than or equal to 10 min.) any temperature within that range, (4) a modest chamber volume of the order of 100 cu cm 3, (5) an easy access to the chamber (by light, magnetic fields, high frequency signals, etc.) for flexibility in application, and (6) an inexpensive and simple construction. This system was extensively and successfully used in studies of electrical properties of solids. To facilitate the construction of replicas in laboratories with similar needs, pictures, graphs, circuit diagrams, lists of parts and suppliers, as well as calibration procedures are provided. Liquid nitrogen is the primary temperature bath. Gaseous nitrogen serves as transfer medium. An electronic control system provides automatic regulation. Author

N70-19003 National Lending Library for Science and Technology, Boston Spa (England).
COAXIAL MICROCALORIMETER
Ralf Bostroem 18 Jul. 1969 17 p Transl. into ENGLISH from Swedish Report FOA-3
(NLL-T-6256-(5809.95); FOA-3: C-3572-68) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

A coaxial microcalorimeter is described for measuring microwave power in the S band at power levels from 2 to 500 mw. The device is based on the dry calorimeter type and the design characteristics are given. The temperature rise in the device is measured by a thermocouple, and a body whose temperature remains stable during the measurement is chosen as a reference. R.B.

N70-19071# California Univ., Livermore. Lawrence Radiation Lab.
DESIGN AND PERFORMANCE CHARACTERISTICS OF A PASSIVE FIN CALORIMETER
Thomas E. Cooper 7 Jul. 1969 35 p refs
(UCRL-50746) Avail: CFSTI

The theoretical and experimental results of a parametric study of various designs for a passive fin calorimeter are presented. Designs are presented which have a capability of determining energy levels to within an estimated plus or minus 5% accuracy. Temperature-sensing paints are applied in long, thin strips to the fin section of the calorimeter and serve as a passive form of instrumentation. The fin calorimeter is designed so that only partial melt is realized on many of the paint strips after energy input, thus allowing the calorimeter to serve as its own control. This facilitates interpretation and increases accuracy. Airbrush application of the temperature-sensing paints give a texture and thickness which is superior to the application of paints with a brush or an aerosol can. Author (NSA)

N70-19196# California Univ., Livermore. Lawrence Radiation Lab.
INFRARED EVALUATION TECHNIQUES FOR Ge(Li) DETECTORS
G. A. Armantrout 14 Oct. 1969 8 p refs Presented at the 16th Nucl. Sci. Symp., San Francisco
(UCRL-71822; CONF-691017-4) Avail: CFSTI

The types of Ge(Li) detector spectrum degradation due to trapping effects are first considered, and a model is presented which explains this degradation in terms of specific phenomena. Then two detector evaluation techniques which utilize infrared light for studying these phenomena are outlined and the significant results obtained using these techniques are presented. The infrared absorption measurement yields information concerning apparent strain in the crystal which can be related to localized trapping effects in the detector. The detector response to monochromatic infrared light determines the presence of localized lithium precipitation (a major cause of spectrum tailing) and permits a quantitative measurement of the important carrier traps in germanium such as the lithium-defect trap, copper, nickel, and iron. Utilizing these measurements, it is possible to completely characterize the performance of a crystal and determine the source of detector degradation in one day. Author (NSA)

N70-19226# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
INEXPENSIVE AIR PROPORTIONAL ALPHA DETECTOR
Valens P. Johnson and Victor R. Griep 25 Sep. 1969 4 p
(Contract AT(29-1)-1106)
(RFP-1166) Avail: CFSTI

An air proportional alpha detector has been developed which is more resistant to contamination, humidity, breakage, and microphonics than other earlier designs. An easily replaced and disposable screen results in a savings of many man-hours spent previously in screen decontamination. Author (NSA)

N70-19227# California Univ., Livermore. Lawrence Radiation Lab.
A THEORETICAL DISCUSSION OF A K-BAND MICROWAVE CAVITY-RESONATOR SPECTROMETER

Lawrence W. Hrubesh, Roger E. Anderson, and Edgar A. Rinehart
29 Aug. 1969 31 p refs
(UCRL-50739) Avail: CFSTI

A microwave spectrometer, designed specifically for the study of transient molecular species in the gas phase, has been constructed using a Fabry–Perot type resonator as the absorption cell. Such a system can be shown to have a theoretical sensitivity comparable to the most sensitive, waveguide-cell spectrometers. The theory of a gas-filled resonator is discussed, the optimization of the inherent characteristics of such a resonator, particularly its sensitivity is considered. It is shown that for nearly optimum conditions, the K-band cavity-resonator spectrometer is capable of measuring weak absorptions with simple homodyne detection techniques. Author (NSA)

N70-19286# Milletron, Inc., Pittsburgh, Pa.
DIGITAL WIDE RANGE NEUTRON DETECTION AND MEASUREMENT CHANNEL
9 Jun. 1969 78 p
(Contract AT(30-1)-3738)
(NYO-3738-15) Avail: CFSTI

A digital wide range neutron detection and measurement channel to continuously monitor the neutron flux from 0.025 to 2.5 × 10 to the 8th power nv is described. Over this range the count rate is monitored from 1 to 1 × 10 to the 10th power cps. The reactor period is monitored from neutron fluxes of 2.5 × 10 to the 10th power nv, which corresponds to 10,000 counts per second up to the capacity of the instrument at 20 billion cps. The wide range is obtained by means of a detector assembly that provides three ranges of detection. These ranges are integrated into the counting circuits so as to span the 11 digits of level display. The low-range detector measures from 0 to 1 million cps; the mid-range, from 5 × 100,000 to 1 × 10 to the 8th power cps; and the high-range above 5 × 10 to the 7th power cps. The switching of ranges is entirely dependent upon the level of operation of the unit and takes place only following determination of the reactor period. This range switching involves gating of the input signal and high voltage supply to the detectors. NSA

N70-19316*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT OF A HIGH FREQUENCY RESPONSE PRESSURE SENSING RAKE FOR TURBOFAN ENGINE TESTS
Everett C. Armentrout Washington Feb. 1970 18 p
(NASA-TM-X-1959; E-5368) Avail: CFSTI CSCL 14B

The application of miniature pressure transducers for dynamic pressure measurements within the air passages of jet engines is a relatively new but practical approach. This report describes the development of a measuring rake having a removable transducer sensor within the rake and a flat amplitude response to 500 Hz. Calibration and development was done through the use of a piston-in-cylinder calibrator using a shaker as the driver. A recommended design is described for pressure-sensing rakes to be used in future jet engine tests. Author

N70-19321*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
THE SATELLITE ATTITUDE SIMULATOR OF THE DFVLR IN OBERPFAFFENHOFEN [DER SATELLITENBEWEGUNGSSIMULATOR DER DFVLR IN OBERPFAFFENHOFEN]
A. Roelker Washington NASA Feb. 1970 35 p refs Transl. into ENGLISH of Deutsche Luft- und Raumfahrt rept. no. 69-20, 1969 p 1–42
(Contract NASw-1692)
(NASA-TT-F-12856; Rept-69-20) Avail: CFSTI CSCL 14B

The report describes the mechanical structure of the satellite attitude simulator and its coordinated instruments. Furthermore, the disturbing torques influencing the simulator are investigated and a method to reduce these torques is explained. Author

N70-19340# Atomic Weapons Research Establishment, Aldermaston (England).
A PORTABLE LET SPECTROMETRY SYSTEM FOR THE CALIBRATION OF THE CONCORDE RADIATION METER
B. Day Aug. 1969 34 p refs
(AWRE-O-57/69) Avail: CFSTI

The development of a LET spectrometry system weighing 70 lb is described. The system uses two detectors, one of which is an ion chamber which measures total absorbed dose. The distribution of absorbed dose in LET is determined with a spherical proportional counter used in the manner first described by Rossi. The responses of the two detectors can be combined to yield the mean quality factor (QF) and Dose Equivalent (DE) of radiation fields of unknown composition. It is shown that air is a satisfactory filling for proportional counters at the low pressures used. By the use of air, the weight of the gas supply for the counter has been greatly reduced compared with existing systems. Distributions of absorbed dose in LET obtained with the system are shown for neutrons over the energy range 0.5 to 20 MeV. Author (NSA)

N70-19394# Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.
ENVIRONMENTAL MONITORING WITH THERMOLUMINESCENT DOSIMETERS. AN EVALUATION OF THE SYSTEM AND A COMPARISON TO PHOTOGRAPHIC METHODS
Chas. K. Fitzsimmons and William H. Horn Oct. 1969 25 p refs Sponsored by AEC
(SWRHL-58-r) Avail: CFSTI

In August 1965, a thermoluminescent dosimeter (TLD) system was put into operation for monitoring gamma radiation exposure in the environment surrounding the Nevada Test Site. A description of the equipment and calibration technique is given. Precision of TLD results at the 95% confidence level has been found to be + or - 3.5%. Accuracy is on the order of + or - 5%. Actual field data ranging from background levels to about 1 R show TLD's to be more satisfactory than film badges for the particular applications described. Author (NSA)

N70-19396# California Univ., Livermore. Lawrence Radiation Lab.
HAZARDS CONTROL Progress Report, Jan.-Apr. 1969
Apr. 1969 64 p refs
(UCRL-50007-69-1) Avail: CFSTI

Ten papers on radiation hazards control are presented: (1) tritium proportional counter with gamma compensation; (2) overburden attenuation measurements for Pu-239 and Pu-241; (3) temperature dependence of a plutonium X-ray survey instrument; (4) in vivo detection of Sr-90 from Bremsstrahlung with thin NaI(Tl) crystal detectors; (5) detection of tritiated water using a plastic-scintillator flow cell; (6) nuclear accident dosimetry comparison; (7) simplified method for generating known concentrations of mercury vapor in air; (8) electrical conductivity of high expansion foam; (9) opacity and composition of smokes from smoldering and burning materials; and reactivity of LiH with H20. E.C.

N70-19476# Institute of Nuclear Research, Warsaw (Poland).
CALIBRATION OF LOGARITHMIC RATE METER
Leslaw Gasiorowski 1969 30 p refs In POLISH
(INR-1089) Avail: CFSTI

Sequent phases of calibration of a Cooke-Yarborough's logarithmic rate meter are described, and the influence of scaling points on the distribution of errors along the instrument scale is discussed. The utilization of the measured characteristic of errors distribution for final calibration points selection is proposed. The influence of current summing resistor values on the error distribution is considered and for illustration of this dependence, a number of calculated curves is shown. The error compensation by means of saturation current choice of the border pumps is proposed. Author (NSA)

N70-19477# Institute of Nuclear Research, Warsaw (Poland).
MEASUREMENT OF BORON CONTENT IN GLASS BY NEUTRON ABSORPTION
Zygmunt Paryski and Bronislaw Machaj 1969 34 p refs In POLISH
(INR-1065) Avail: CFSTI

A neutron absorption meter for measuring the boron content in glass is described. Contents of B2O3 up to 25% can be determined. The stability and accuracy of the meter are discussed. Author (NSA)

N70-19548# California Univ., Berkeley. Lawrence Radiation Lab.
FATIGUE LIFE GAGES ON A 46000 k-VA GENERATOR UNDER PULSED LOADING
Roland S. Krevitt Aug. 1969 63 p refs
(Contract W-7405-eng-48)
(UCRL-18423-Rev) Avail: CFSTI

On December 19, 1966, near catastrophic fatigue failures in two 46,000-kVA generators were discovered; a 6-month shutdown of a major nuclear physics research facility resulted. The cost of replacing the failed parts was $330,000. The Bevatron is a proton accelerator. A large electromagnet guides the protons in a circular path, and because of the nature of the acceleration cycle, the magnet must be pulsed 11 times per minute with a peak coil current of 8,400 A and a peak voltage of 16,000 V. This results in a pulsed demand on the generators that supply power to the electromagnet, and causes severe stress in the generator armatures. These cyclic stresses led to fatigue failures. The use of S/N fatigue life gages to detect possible future armature fatigue damage is described. Author (NSA)

N70-19605*# National Aeronautics and Space Administration, Washington, D.C.
GAIN STABILIZATION OF SCINTILLATION SPECTROMETERS [STABILISIERUNG DER VERSTAERKUNG VON SCINTILLATIONSSPEKTROMETERN]
Angelo Comunetti Jan. 1970 36 p refs Transl. into ENGLISH from Swiss rept. EIR-66, Jun. 1964 41 p
(NASA-TT-F-12601; EIR-66) Avail: CFSTI CSCL 14B

The problems associated with the photomultiplier in a scintillation spectrometer are discussed. Methods are described for stabilizing the gain with the aid of a reference system. It is shown that stabilization of the whole chain of components in a spectrometer, including the crystal, can be accomplished only by using a reference source which has radiation of the same kind as that being investigated. It is also shown that the error signal is obtained at the output of the analyzer. R.B.

N70-19641# Underwriters Labs., Inc., Chicago, Ill.
ISOTOPE DEVICE SAFETY TESTING STUDY: INDUSTRIAL GAUGES AND RADIOGRAPHY DEVICES
10 Jul. 1969 85 p refs
(Contract AT(40-1)-3610)
(ORO-3610-1) Avail: CFSTI

Presented is a review of safety considerations concerning industrial gaging equipment and radiography devices containing radioisotopes. The investigation included studies of the construction of these devices and their installation and operation in the field. Following these studies, commercial samples of these devices, representative of equipment now in commercial use, were set up in a laboratory and subjected to a number of tests intended to evaluate features of the devices relating to their safe use and operation. Descriptions of these tests, and the results obtained, are included in this report, which is concluded with recommendations for performance tests applicable to the safety evaluation of these devices. Author (NSA)

N70-19642# California Univ., Livermore. Lawrence Radiation Lab.
DEFECT STUDY AND IDENTIFICATION IN Ge(Li) P-N JUNCTION RADIATION DETECTORS
G. A. Armantrout 3 Sep. 1969 33 p refs Presented at the Electron. Mater. Conf., Boston, 24-27 Aug. 1969 Submitted for publication Sponsored by AEC
(UCRL-71679; Conf-690821-1) Avail: CFSTI

Ge(Li) detectors, which are very high resolution gamma-ray spectrometers, are extremely sensitive to defects in the junction of the detector. These defects act as charge-trapping centers and seriously degrade the detector performance. Several techniques, which include the detector monochromatic infrared response, reverse current characteristics, and performance analysis have been used to study these defects. The results indicate that degradation of the detector spectrum is due both to detector inhomogeneities and traps. The main inhomogeneity is caused by a localized variation in the precipitation rate of lithium, which results in weak detector collection fields and heavier localized trapping. The properties of copper, nickel, and iron as traps indicate that the presence of lithium modifies the trap behavior by shielding the Coulomb force and by shifting the deep-trap energy states. The most important traps are those due to lithium effects. Author (NSA)

N70-19645# California Univ., Livermore. Lawrence Radiation Lab.
PROCESSING BY COMPUTER OF DATA SUPPLIED BY A QUADRUPOLE MASS SPECTROMETER
P. Ronteix (RIBER Ultra-Vacuum French Co.) [1969] 12 p refs Transl. into ENGLISH from Chim. Anal., (Paris), V. 51, 1969 p 290-295 Presented at the Colloq. on the Use of In Line Computers, Paris, 9 Jan. 1969
(UCRL-TRANS-10381) Avail: CFSTI

Because of the speed of scanning and the linear nature of the spectra, quadrupole mass spectrometers simplify the establishment of a simple relation between the spectrometer and the adjustments of the operational controls on the computer. The possibilities of a quadrupole spectrometer-computer combination are described; and it is shown how the computer and the operator, working together, can perform operations corresponding to those carried out by a large computer with more complex programming. Author (NSA)

N70-19654# California Univ., Livermore. Lawrence Radiation Lab.
DOUBLE-DRIFT THIN-WINDOW PLANAR Ge(Li) DETECTORS
Dan Okubo 16 Oct. 1969 8 p refs Presented at 16th Nucl. Sci. Symp., San Francisco, 29-31 Oct. 1969 Sponsored by AEC
(UCRL-71787; CONF-691017-2) Avail: CFSTI

An improved method for fabricating a thin-window planar detector was developed at Lawrence Radiation Laboratory, Livermore. This detector is designed to analyze spectra of low-energy as well as high-energy gamma and X-rays. The detector has a planar configuration with a relatively large gold surface barrier entry window. The main advantage of this detector is its faster drifting time coupled with minimum waste of material. The fabrication of this detector employed the best concepts of Goulding's thin-window detector and Mann's double-drifted detector. In Goulding's model, the geometry of the detector is cut so that following drift, a P-tyde ring remains around the base of the detector. Gold is then evaporated on the intrinsic region surrounded by the P-type ring, thereby forming the thin entry window. The double-drift, thin-window planar method is employed both to create this P-ring without extensive cutting, and to increase the effective compensation rate. NSA

N70-19688# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NEW MASS SPECTROMETER FOR MEASUREMENTS OF

VERY SMALL ISOTOPIC DIFFERENCES BETWEEN TWO URANIUM SAMPLES

G. Nief, M. Lucas, and R. Bir 27 Jan. 1969 4 p Presented at the 17th Ann. Conf. on Mass Spectrometry and Allied Topics, Dallas, 18-23 May 1969

(CEA-CONF-1346; CONF-690523-3) Avail: CFSTI

The design of a new mass spectrometer to measure very small isotopic differences between two UF6 samples is described. The main features of the spectrometer include: differential pumping with ionic pumps; special ion source mounting with direct gas introduction in the ionization chamber; use of a capillary as leak; special collector device allowing to monitor the position of the beams to be measured; gas flow inlet system giving a constant and permanent pressure in the ion source; and digitalized device for isotopic ratios recording. The analytic procedures and the performances are given. Author (NSA)

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N70-18367# Denver Univ., Colo. Center for High Energy Forming.

CENTER FOR HIGH ENERGY FORMING Quarterly Technical Progress Report

Jimmy D. Mote 1 Oct. 1969 24 p Prepared in cooperation with Martin Marietta Corp., Denver

(Contract DA-19-066-AMC-266(X); ARPA Order 720)

(AD-696466; AMRA-CR-66-05/21; QTPR-17) Avail: CFSTI CSCL 13/8

This report summarizes results in the following areas: (a) Measurement of the dynamic loads on an explosive forming die. (b) Applications of explosive welding to hardware configurations. (c) Flange buckling of explosively formed domes. (d) Explosive punching of dual hardness armor. (e) Mechanics of high energy forming. (f) Electromagnetic forming. (g) Explosive forming of thick blanks. (h) Prediction of edge pull-in in explosively formed domes. (i) Fracture toughness of explosively formed high strength steels. (j) Terminal properties of titanium. (k) Explosive welding. (l) Microstructural effects of heat treatment on the bond interface of explosively welded metals. (m) Explosive welding of dual hardness steel plate. (n) Explosive powder compaction. Author (TAB)

N70-18420# North American Rockwell Corp., Downey, Calif.

FLEXURE GUIDES FOR VIBRATION TESTING

Alexander Yorgiadis and Stanley Barrett *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 157-174 refs (See N70-18404 07-32)

Avail: CFSTI

Flexure guides are described and their mechanical characteristics are expressed in terms of significant dimensions and the material properties. Mathematical relationships are derived for the six natural frequencies of the vibration system consisting of a series of parallel flat plate flexures, and a fixture specimen assembly. The basic theory flexure design and the parameters in which the designer must consider are discussed. Author

N70-18421# Lear Siegler, Inc., Grand Rapids, Mich. Instrument Div.

A COMPRESSION-FASTENED GENERAL-PURPOSE VIBRATION AND SHOCK FIXTURE

Warren C. Boecher *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 175-186 refs (See N70-18404 07-32)

Avail: CFSTI

The fixture under discussion is the result of a program to achieve the economies of a universal fixture for vibrating and shocking different units with little or no compromise from the results that would have been obtained if an individual fixture was specially fabricated for each one. A method of wedge compression was developed to install individual adapter plates into a mother fixture. This method eliminates the spring constants of bolted connections, and the discontinuities of welded connections, resulting in a high frequency first resonance with low magnification and cross mode vibration Author

N70-18425# Hazeltine Corp., Little Neck, N.Y.

ANALYSIS AND DESIGN OF RESONANT FIXTURES TO AMPLIFY VIBRATOR OUTPUT

J. Verga *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 221-232 refs (See N70-18404 07-32)

Avail: CFSTI

The analysis and design of resonant fixtures to amplify vibrator output is described. When the acceleration capacity of the vibrator head output is limited, greater acceleration levels are obtainable by interposing a resonating member (designed not to fatigue) between the driving head of the vibrator and the test specimen. The resonating member, hereafter, is referred to as the resonant fixture. General requirements, design concepts, derivation and discussion of equations and curves, and solution of a typical problem are described and conclusions presented. Author

N70-18451# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF DIE DEFORMATION ON THE NORMAL STRESS DISTRIBUTION AT THE CONTACT SURFACE DURING THE PRESSING OF THIN BODIES

P. F. Ivanushkin et al 8 Sep. 1969 16 p refs Transl. into ENGLISH from Kuznechno-Shtampovochnoe Proizv., (USSR), v. 9, no. 5, 1967 p 16-20

(AD-696233; FTD-MT-24-139-69) Avail: CFSTI CSCL 13/9

To determine the effect of the deformation of dies on the normal stress distribution at the contact surface in upsetting thin bodies without widening, lead specimens of various lengths, 7 mm wide, and 4.7, 1.55 and 0.85 mm thick, were pressed with a 50 ton press using rectangular trough-like dies with contact faces of various concavity. The experiments showed that in upsetting thin bodies, the character of the normal stress distribution at the contact surface is determined by the die deformation. In all cases, the normal stresses in the center of the deformed body decreased with increasing concavity of the dies. The effect of the die deformation on the stress distribution became more pronounced as the thickness of the pressed specimens decreased and as the length-to-thickness ratio in the specimens increased. For example, in compression under identical conditions, specimens 240 mm long with a length-to-height ratio of 51, 155 and 283 had a respective deformation of 0.17, 0.09 and 0.08 mm, and the respective central plastically non-deformed portions were 100, 164, and 196 mm, or 0.41, 0.68 and 0.81 of the length of the specimens after deformation. Hence, to increase the precision of the geometric dimensions and to obtain more complete filling of the die groove in the center in die forging of thin parts, the dies should be suitably profiled to offset their deformation. TAB

N70-18510# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF WEAR RESISTANCE OF HARD-ALLOY CUTTING TOOLS IN VARIOUS GAS MEDIA

N. S. Kolev 17 Mar. 1969 8 p refs Transl. into ENGLISH from Izv. Vysah. Ucheb. Zaved., Mashinostro. (Moscow), no. 10, 1966 p 134-136

(AD-696511; FTD-HT-23-1112-68) Avail: CFSTI CSCL 13/9

An attempt is made to explain some situations of one of the causes of wear of a hard-alloy tool, namely, oxidation of the contacting surfaces in the process of cutting metals.
Author (TAB)

N70-18537# Boeing Co., Renton, Wash. Commercial Airplane Div.

THE INFLUENCE OF WELD DEFECTS AND REPAIR WELDS ON PERFORMANCE

D. V. Lindh 5 Sep. 1969 68 p refs
(AD-697243; D6-24409) Avail: CFSTI CSCL 13/5

The evaluation of a semi-empirical method for predicting the influence of weld defects on properties is described. Weld defects are shown to be very harmful to the fatigue properties of a weldment. The effect of weld repairs on properties are discussed, and the possibility of introducing severe defects during repair welding is considered.
Author (TAB)

N70-18540 National Lending Library for Science and Technology, Boston Spa (England).

OUTPUT AND DIMENSIONAL ACCURACY IN ELECTROLYTIC MACHINING [VOPROSY PROIZVODITELNOSTI I TOCHNOSTI RAZMERNOI ELEKTROKHIMICHESKOI OBRABOTKI]

E. Ya. Grodzinskii Dec. 1969 15 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabot. Mat. (USSR), No. 5, 1968 p 52-58
(NLL-RTS-5219) Avail: Natl. Lending Library, Boston Spa, Engl.: 17s 6d or 2 NLL photocopy coupons

The methods of increased productivity and improved accuracy in electrolytic machining are examined. It is shown that the principal way of achieving increased productivity is by reduction of inter-electrode gap and that the main obstacle involved is the overheating of the electrolyte, increased content of by-products of electrode reactions, and the formation of short circuits. The general problems of dimensional accuracy are also examined by comparisnn of the shape of the anode with that of the tool and the comparison of the degree of agreement of geometric characteristics in a group of products.
Author

N70-18665 National Lending Library for Science and Technology, Boston Spa (England).

DETERMINING THE CUTTING ZONE ON THE HEAD EDGES OF HOBS [OPREDELENIE ZONY RABOTY GOLOOVNYKH KROMOK CHERVYACHNYKH FREZ]

N. G. Stakhanov Oct. 1969 10 p refs Transl. into ENGLISH from Progressivn. Tekhnol. Mashinostr. (Tula), 1966 p 123-128
(NLL-RTS-5370) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

The operating conditions of the cutting edges of hobs are studied, and a kinematic method of analysis for determination of which points on the cutting edges participate in cutting, and the instants at which the points begin to cut and stop cutting is presented. A method is proposed for calculating the cutting zone on head edges of hobs for spur gear wheels when the edges are located on the cylindrical surface.
J.M.

N70-18675*# IIT Research Inst., Chicago, Ill. Technology Center.

A STUDY OF OPTIMUM METHODS FOR PREPARING ALUMINUM SURFACES FOR WELDING Final Report, 13 Jun. 1968-13 Jul. 1969

10 Jul. 1969 93 p refs
(Contract NAS8-21354)
(NASA-CR-102451; IITRI-B6092-13) Avail: CFSTI CSCL 13H

Research was performed to develop and demonstrate practical techniques for preparing the weld surfaces of aluminum components. Two techniques were evaluated: dry machining as the primary cleaning method and electrical discharge cleaning as a supplemental method for use if dry machined surfaces were subsequently contaminated. Dry machining proved practical and a prototype device, which was based on this method, was designed and fabricated. Electrical discharge cleaning proved unacceptable under the conditions employed in the program. The prototype device was designed to prepare the abutting edges and two adjacent surfaces simultaneously utilizing dry machining in the face-milling mode. Evaluations of the device showed it to be: (1) practical; (2) capable of preparing surfaces with a low defect potential; (3) adaptable to components of varying size and configuration; and (4) capable of maintaining the dimensional tolerances required in advanced aerospace structures.
Author

N70-18761*# Mechanical Technology, Inc., Latham, N.Y.

ANALYSIS, DESIGN AND PROTOTYPE DEVELOPMENT OF SQUEEZE FILM BEARINGS FOR AB-5 GYRO. PHASE 5: DEVELOPMENT OF AN INTEGRAL DESIGN PROTOTYPE SQUEEZE FILM BEARING SUPPORTING A LIVE AB-5 GYRO FLOAT Final Report

L. Hoogenboom and T. Chiang 30 Apr. 1969 104 p refs
(Contract NAS8-11678)
(NASA-CR-102433; MTI-69TR11) Avail: CFSTI CSCL 13I

The concept of integral-design squeeze-film transducer has been demonstrated. The key to the success of this new concept is to install the piezoelectric drivers into the transducer structure by shrink fit. This eliminates the bolt and screw joints in the previous design, and greatly reduces the power input to the transducer. Two transducers, one experimental transducer and one prototype transducer accommodating a live AB-5 gyro have been designed and fabricated using the integral-design concept. Both transducers were successfully operated at ultrasonic frequencies with ample amplitude for squeeze-film application. The power required to drive the transducer is considerably lower than that of previous designs.
Author

N70-18768*# Mechanical Technology, Inc., Latham, N.Y.

ANALYSIS, DESIGN AND PROTOTYPE DEVELOPMENT OF SQUEEZE FILM BEARINGS FOR AB-5 GYRO. PHASE 6: ANALYTICAL INVESTIGATION ON DYNAMIC RESPONSES AND START UP PROCESS OF SQUEEZE FILM BEARINGS Final Report

T. Chiang and C. H. T. Pan Apr. 1969 51 p refs
(Contract NAS8-11678)
(NASA-CR-102431; MTI-69TR7) Avail: CFSTI CSCL 13I

Synchronous responses of spherical and conical squeeze-film bearing systems were analyzed by two-mass model activation through gimbal suspension of a gyro. Results showed that: (1) dynamic responses of the journal and the wheel were typical for a two-degree of freedom system; (2) responses of the journal may result in higher load capacity and stiffness at a certain squeeze frequency range; (3) at squeeze frequency much higher than the critical frequencies, both the journal and the wheel responses have negligibly small amplitudes; and (4) squeeze frequency should be higher than the critical frequencies to prevent wheel excitation.
G.G.

N70-18818# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF THE ELECTRICAL EXPLOSION OF A WIRE FOR DEFORMATION OF A SOLID BODY

V. F. Vygovskii et al 6 May 1969 7 p refs Transl. into ENGLISH from Izd-Vo Nauka, (Moscow), 1967 p 114-115
(AD-696306; FTD-HT-23-1376-68) Avail: CFSTI CSCL 13/8

Experiments were conducted in the formation of metal junctions by utilizing the electric explosion of a wire. A circuit was used. Two metal objects, a copper tube (outside diameter, 20 mm; wall thickness, 3 mm) and a steel ring (inside diameter, 20.5 mm; outside diameter, 40 mm), were joined in the following manner. The

exploding wire, wound spirally around an insulated straight conductor, was inserted into the copper tube which had been previously filled with plasticine. The copper tube was then inserted into the steel ring and the wire exploded electrically. The pressure pulse, applied on the inside of the copper tube, deformed the tube radially and joined it with the ring. In this manner a very strong joint was obtained between the tube and the ring. Author (TAB)

N70-18849 Pennsylvania State Univ., University Park.
THE CONTRIBUTION OF DEFORMATION LOSSES TO RUBBER FRICTION
Rudolph Reuven Hegmon (Ph.D. Thesis) 1968 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-9766

In actual friction processes both surface and bulk friction are present. This study was designed to investigate bulk friction only. The analysis uses the difference between the input and output energy of deformation to find the bulk friction. By postulating a model of a rigid slider, divided into three sections, a solution to the problem was obtained. The first and third sections of the slider are analyzed for the energy input and output respectively. In the second section constant deformation is assumed and the viscoelastic properties of the rubber are introduced to calculate the relaxation of pressure. Combining the results of the three sections, a relation is obtained for the coefficient of bulk friction as function of material properties and operating conditions. The velocity dependence of the coefficient of bulk friction is introduced through the frequency-velocity relationship. To measure pure bulk friction, a total separation of surface and bulk friction is required. This is achieved by using an independently mounted tape between the two sliding surfaces. The tape takes up all the surface friction. The bulk friction is transmitted through the tape and is measured. Experimental data obtained with this method are in excellent agreement with the analytical results. Dissert. Abstr.

N70-18854*# Mechanical Technology, Inc., Latham, N.Y.
ON THE START-UP PROCESS IN A GASEOUS SQUEEZE-FILM THRUST CIRCULAR DISK
T. Chiang, C. H. T. Pan, and V. Castelli Apr. 1969 27 p refs (Contract NAS8-11678)
(NASA-CR-102432; MTI-69TR16) Avail: CFSTI CSCL 13I

The start-up process of a squeeze-film thrust bearing was analyzed with the simplification that the float starts off with a given velocity and a given elevation different from the equilibrium film thickness. The results show that when the gap is greater than the equilibrium film thickness C, the squeeze-film force is not large enough to support the float; consequently, the gap would decrease. When the gap decreases to a value equal to C, it will continue to decrease because of the inertia of the float. But now the squeeze-film force is building up until it reaches a value that will compensate the float inertia; at that point, the gap ceases to decrease. The squeeze-film force is now too large and the float starts to move up. It will over-shoot the equilibrium position and the process will repeat itself in a convergent manner. Eventually, the float would settle down at the equilibrium position. Author

N70-18878 Wisconsin Univ., Madison.
TEMPERATURE HISTORIES IN A THIN STEEL PLATE WELDED WITH TUNGSTEN INERT GAS PROCESS
Vjekoslav Pavelic (Ph.D. Thesis) 1968 271 p
Avail: Univ. Microfilms: HC $12.40/Microfilm $3.50 Order No. 68-16014

The following method for predicitng temperature distributions in a two-dimensional plate was developed and compared with experimental data. The governing differential equation was solved numerically by a finite difference method. The shape of the molten pool was correlated to the welding variables and this isotherm was then used as one boundary condition. Since experiments showed that a significant amount of heat was transferred from the arc to the solid metal without going through the molten pool, a correlation showing the amount and the distribution of this heat over the solid material was developed. Provision was also made for inclusion of convective and radiative losses from the heated plate to the surroundings as well as variable properties. The theory developed for a line source of heat provided the basic welding parameters used to correlate the maximum width and length of the molten pool. Experimental data were used to develop needed correction factors. Dissert. Abstr.

N70-18925*# Battelle Memorial Inst., Columbus, Ohio. Army Missile Command, Redstone Arsenal, Ala.
ROLLING-CONTACT BEARING REFERENCE SUMMARY
William A. Glaeser, David B. Cox, Keith F. Dufrane, and Jerrold W. Kannel 19 Sep. 1969 123 p refs Prepared for Army Missile Command, Redstone Arsenal, Ala.
(NASA Order H-55404A; Contract DAAH01-67-C-1821)
(NASA-CR-102423; RSIC-932) Avail: CFSTI CSCL 13I

This reference summary contains information concerning the design and performance of rolling-contact bearings (ball bearings, roller bearings, and needle bearings). It is broken down into five general topics: (1) principles of rolling contact bearings; (2) lubricants and materials; (3) special aerospace bearing applications; (4) failure diagnosis; and (5) future trends in rolling-contact bearing lubrication. Special design and operating conditions encountered in aerospace applications are emphasized, such as high speed, high temperature, hard vacuum, cryogenic temperatures, and oscillating motion. Various lubricants used in rolling-contact bearings, including oils, greases, solid lubricants, and special lubricants for an aerospace environment, are discussed and evaluated. Author

N70-18927 National Lending Library for Science and Technology, Boston Spa (England).
NITROGEN POROSITY IN WELDS [PORISTOST SVARNYKH SHVOV OT AZOTA]
V. V. Podgaetskii Sep. 1969 16 p refs Transl. into ENGLISH from Tekhnika (Kiev), 1964 p 350-361
(NLL-RTS-4836) Avail: Natl. Lending Library, Boston Spa, Engl.: 30s or 4 NLL photocopy coupons

The relationship between nitrogen porosity in welds and the solubility of nitrogen in multi-component iron alloys was investigated. The likelihood of nitrogen causing pores to form during welding is found to be dependent upon how much of the nitrogen dissolved in the molten metal is evolved during its solidification. It is also shown that elements which increase the solubility of nitrogen in steel lower its coefficient of activity. To calculate the solubility of nitrogen in a molten grade steel, the effect of the alloying elements on the coefficient of activity of the dissolved nitrogen was determined. The coefficient of activity was converted to the solubility of nitrogen by use of a logarithmic equation. Calculations agree well with experimental data obtained in previous research. Other factors that influence the porosity in welds are discussed. Characterization data for various welding processes are included. D.L.G.

N70-18929 National Lending Library for Science and Technology, Boston Spa (England).
DAMPING SELF-OSCILLATIONS OF ROTORS WITH GAS-FILM BEARINGS [O DEMPFIROVANII AVTOKOLEBANIY ROTOROV S GAZOVYMI PODSHIPNIKAMI]
S. I. Sergeev Sep. 1969 13 p refs Transl. into ENGLISH from Tr. Vses. Nauchn.-Issled Inst. Kriogen. Kislorodn. i Kompress Mashinostr. (USSR), v. 10, 1965 p 80-86
(NLL-RTS-5156) Avail: Natl. Lending Library, Boston Spa, Engl.: 17s 6d or 2 NLL photocopy coupons

The theoretical feasibility was investigated of using elastic-damped mountings to ensure stability of stiff, lightly-loaded

rotors running in cylindrical, gas-film, self-acting bearings. Differential equations that describe the forces acting upon the rotor are developed and the unknown coordinates of motion are expressed as exponential time functions in order to obtain a characteristic equation of the complex frequency. It was determined that: (1) with ridgid bearings the rotor is unstable even if the static load is light; (2) with elastically damped bearings the rotor is unstable at very low angular velocity and stable at fairly high angular velocity; and (3) the region of stability extends with increases in the elastic yield of the damper and gas viscosity, and with reductions in the bearing mass and lubricant film thickness. Further calculations indicate that it is possible to achieve effective damping of auto-oscillation of rotors with gas film bearings, however, it is necessary to overcome difficulties in developing bearings which are not too heavy and to protect against misalignment of moving parts. D.L.G.

N70-18967 National Lending Library for Science and Technology, Boston Spa (England).
SAFETY DISTANCES BETWEEN PARALLEL PIPELINES FOR FLAMMABLE LIQUIDS AND GASES [SICHERHEITSABSTAENDE ZWISCHEN PARALLEL VERLEGTEN FERNLEITUNGEN FUER BRENNBARE FLUESSIGKEITEN UND GASE]
N. Helwig et al 10 Sep. 1969 11 p refs Transl. into ENGLISH from PTB Mitt. (German), v. 79, no. 2, Apr. 1969 p 97-101
(NLL-SMRE-Trans-5751-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The number of fires and explosions and the mechanical effects of the emerging liquids and gases are analyzed from available accident reports. Based on the dimensions of the cavity created when a gas pipe bursts, provisional figures are given for the safe distance between parallel pipelines as a function of pipe diameter. Author

N70-18981*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF 3-1/2 PERCENT SILICON ON ADHESION, FRICTION, AND WEAR OF IRON IN VARIOUS MEDIA
Donald H. Buckley Washington Feb. 1970 17 p refs
(NASA-TN-D-5667; E-4739) Avail: CFSTI CSCL 13I

Sliding friction experiments were conducted with 3.5 percent silicon-iron single crystals, polycrystals, and rolled sheet. The various media of the experiment included vacuum, air, water, water with ferric chloride, hexadecane, hexadecane with oleic acid, and oleic acid. The results of these studies indicate that: (1) the friction is anisotropic with respect to single crystals and rolled sheet, (2) the brittle to ductile transition influences surface deformation but not friction coefficient, (3) the friction coefficient for silicon-iron is more sensitive to small concentrations of oxygen than pure iron, and (4) the presence of surface active species influenced the friction coefficient but had little effect on surface deformation. Author

N70-19063# Aeronautical Research Labs., Melbourne (Australia).
THE CALIBRATION OF THE ARL AXIAL RANDOM NOISE FATIGUE MACHINE
Ningaiah and C. W. Sutton Dec. 1968 23 p refs
(ARL/SM-335) Avail: CFSTI

Calibration tests were made on an axial load random noise fatigue machine. The machine has one mechanical resonance within the frequency range of interest, and the distribution of instantaneous values of output force is Gaussian for all operating conditions. The system damping may be changed within limits, and its effect may be observed in changes in the power spectrum of output force or in the distribution function of extremes (peaks or troughs) in the wave form. For minimum damping this approximates to the Rayleigh form, while with increased damping the distribution converges towards the Gaussian form. It appears that, for practical purposes, the theory of Rice predicts acceptably the distribution of peak and trough values in the stress wave form. Author

N70-19095# National Lead Co. of Ohio, Cincinnati.
ROLLING OF URANIUM CONTAINING SMALL QUANTITIES OF IRON, SILICON, AND ALUMINUM
H. W. Hesselbrock Oct. 1969 15 p refs
(Contract AT(30-1)-1156)
(NLCO-1043) Avail: CFSTI

Three alloys of uranium (containing various combinations of iron, silicon, and aluminum in small quantities) and an unalloyed control sample were rolled in an experimental mill. The samples were rolled through four passes at initial temperatures ranging from 1000 to 1300°F. Roll separating forces were measured with strain-gage load cells, and the data were subjected to regression analyses. It was found that roll separating forces decreased linearly with increasing billet temperatures up to 1125°F. As the temperature continued to rise above that temperature, roll forces continued to decrease, but at a lesser rate, until the beta transformation temperature was reached. The response to deformation of the three alloys differed from that of the control sample. The results indicate that the use of a lower initial billet temperature in the production rolling mill would be advantageous. Author (NSA)

N70-19108 National Lending Library for Science and Technology, Boston Spa (England).
TIGHTNESS OF CASINGS FOR EXPLOSION-PROOF ELECTRIC EQUIPMENT PROTECTED BY THE PRESSURIZED ENCLOSURE METHOD [DICHTHEIT VON GEHAEUSEN EXPLOSIONS-GESCHUETZTER ELEKTRISCHER BETRIEBSMITTEL IN ZUENDSCHUTZART FREMDBELUEFTUNG]
F. Schebsdat Jul. 1969 7 p refs Transl. into ENGLISH from PTB Mitt. (German), v. 79, no. 2, Apr. 1969 p 101 – 103
(NLL-SMRE-Trans-7552-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Apparatus with "pressurized enclosure" type of equipment must be sufficiently tight, because in case of fire, e.g. resulting from a breakdown in the insulation, a continuous supply of fresh air may cause the fire to burn with such intensity that flames may pass through the gaps and ignite the explosive mixture outside the apparatus. The possibility of ignition through the gaps was tested from this aspect. Author

N70-19124*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COOLING REQUIREMENTS OF BALL BEARINGS LUBRICATED BY GLASS-FIBER-FILLED POLYTETRAFLUOROETHYLENE RETAINERS IN COLD HYDROGEN GAS
Harold H. Coe, David E. Brewe, and Herbert W. Scibbe Washington Feb. 1970 26 p refs
(NASA-TN-D-5607; E-5222) Avail: CFSTI CSCL 13I

Experiments were performed with 40 mm bore ball bearings operating at shaft speeds to 35,000 rpm and thrust loads to 400 lbf (1780 N) in 60 R (33 K) hydrogen gas. The minimum coolant flow rate equation developed for bearings equipped with this retainer material was similar to the equation determined in a previous study for bearings with a bronze-filled polytetrafluoroethylene retainer. Retainer wear rate was very low; some inner-race ball-track wear was evident for bearings that were run for more than 7 hours. Author

N70-19178*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EVALUATION OF A FLASH X-RAY TECHNIQUE FOR RECESSION MEASUREMENTS IN ABLATIVE MATERIALS
William D. Brewer and Philip C. Kassel, Jr. Washington Feb. 1970 23 p refs
(NASA-TN-D-5669; L-6764) Avail: CFSTI CSCL 13H

A flash X-ray technique has been developed that permits the determination of the surface and interface recessions of ablative

materials during testing in arc-jet facilities. Use is made of a system with which several radiographs of a specimen can be made during a single test. The flash X-ray system and measurement techniques are discussed. Surface and interface recessions are obtained for three charring ablators tested in an arc-jet facility. The data obtained with the X-ray system are compared with results obtained by direct measurement on sectioned specimens after testing and with analytical predictions. The agreement among the results is good. Thus the X-ray technique can be used effectively to obtain reliable recession measurements. For the phenolic-nylon materials tested, the char density increases significantly toward the front surface. An epoxy-base material tested shows no char density gradient. Also, there appears to be a reduction in density of the charring materials before any visible change takes place. Author

N70-19200# Idaho Nuclear Corp., Idaho Falls.
ATR PRIMARY COOLANT SYSTEM CHECK VALVE PROBLEM ANALYSIS AND CORRECTION
T. K. Burr Oct. 1969 56 p refs
(Contract AT(10-1)-1230)
(IN-1186-Suppl-1) Avail: CFSTI

A continuing surveillance program for the purpose of detecting a change in the primary coolant system check valve performance is described. An alternate bearing design is presented which could replace the existing bearings should the findings of the surveillance program indicate a change is necessary. Author (NSA)

N70-19213# Los Alamos Scientific Lab., N. Mex.
FABRICATION OF BORON CARBIDE RINGS AND DISKS
H. Sheinberg, T. Herrera, and J. Kostacopoulos 25 Apr. 1969 11 p
(Contract W-7405-eng-36)
(LA-4164) Avail: CFSTI

Boron carbide components, varying in size from 3.2-in.-dia by 3.0-in.-long cylinders to 7.7-in.-OD by 6.2-in.-ID by 2.4-in.-long rings, were hot pressed to a minimum density of 95% of theoretical for use as neutron absorbers in a physics experiment. Powder characteristics, die design, pressing conditions, and the dimensional and density variations of the hot-pressed components are discussed. Author (NSA)

N70-19225# Gulf General Atomic, San Diego, Calif.
STIFFNESS OF A LAMINATED ELASTOMERIC BEARING
P. D. Smith 14 May 1969 27 p refs
(Contract AT(04-3)-167)
(GAMD-9375) Avail: CFSTI

A method has been given which will provide reasonable analytical values for the stiffness of a laminated neoprene bridge bearing. It is believed that the formulas presented here represent the best approximation obtainable without resorting to a three-dimensional elastic analysis. Test values, if they exist, are to be preferred, but, in the absence of test data, these formulas provide adequate information for design calculations. The formulas are summarized. 4 references. Author (NSA)

N70-19251 Wisconsin Univ., Madison.
AN ANALYSIS OF THE CUTTING-TOOL TEMPERATURE RESPONSES IN FACE-MILLING
Kuo-King Wang (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-16032

The milling tool temperature responses are characterized by intermittent nature. The tool temperatures were measured simultaneously for a multitooth cutter. Physical simulation method was introduced for the study of the milling temperature responses. A numerical method was presented to solve the theoretical tool temperature equation with a given tool configuration and the boundary conditions. Tool temperatures from as many as eight teeth were simultaneously measured using a new multi-signal pickup. The temperatures were sensed by standard thermocouples on the back of the tool bit. Temperature distributions across the tool bit for various cutting conditions were established from the experimental data. The results indicate that the average tool temperature of a multitooth milling cutter is higher than that of a flycutter. Dissert. Abstr.

N70-19318*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION AND WEAR INTERDISCIPLINARY WORKSHOP
E. E. Bisson and P. M. Ku, eds. (Southwest Res. Inst.) [1968] 88 p refs Conf. held at Cleveland, 19–21 Nov. 1968
(NASA-TM-X-52748) Avail: CFSTI CSCL 13H

Discussed are sliding friction and wear problems under unlubricated and boundary-lubricated conditions in the following areas: (1) surfaces and surface interactions; (2) unlubricated and lubricated wear; (3) boundary lubrication and wear; (4) aerospace lubrication; (5) lubrication, friction, and wear under gross plastic deformation; and (6) extreme temperature lubrication. The effect of lubricant-metal-atmosphere interaction on boundary lubrication is recognized in all discussions and the considerable difficulties in performing controlled, critical experiments are pointed out. G.G.

N70-19324*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF EXPERIMENTAL AND IDEAL LEAKAGE FLOWS THROUGH LABYRINTH SEALS FOR VERY SMALL PRESSURE DIFFERENCES
Frederick C. Yeh and Reeves P. Cochran Washington Feb. 1970 26 p refs
(NASA-TM-X-1958; E-5336) Avail: CFSTI CSCL 13K

Leakage flows for stationary straight-through and stepped labyrinth seals were obtained experimentally with room-temperature air for pressure differences of 0.2 to 1.4 inches of water (50 to 350 N/m sq) and pressure ratios of 0.9990 to 0.9999. The analytical leakage prediction method of Egli was shown to be valid for the range of test conditions. Leakage flow increased about 5 percent through both test seals when eccentricity ratio was changed from 0 to 0.72. The straight-through seal was insensitive to flow direction. Leakage flow for the stepped seal was 7 percent greater with flow over the step than with flow against the step. Author

N70-19336*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EVALUATION OF HOLLOWED (DRILLED) BALLS IN BALL BEARINGS AT DN VALUES TO 2 MILLION
Harold H. Coe, Herbert W. Scibbe, and William J. Anderson Jan. 1970 11 p
(NASA-TM-X-52747) Avail: CFSTI CSCL 13I

Two 75 millimeter bore bearings having balls with a 50-percent weight reduction were operated at 500 lb. thrust load at speeds to 28,000 rpm. The weight reduction was achieved by machining (drilling) a concentric hole through each ball. More than 100 hours running time was accumulated on one bearing, with 65 hours at DN values above 1.5 million. Bearing torque and outer race temperature data were obtained and compared with bearings having either spherically hollow or conventional solid balls. Both air-oil mist and oil jet lubrication were used. Author

N70-19389# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
CO-AXIAL WATER-COOLING FEED-THROUGHS FOR HIGH VACUUM PROCESSES
T. Van Vorous, R. Donald Bowdey, and O. C. Hammit 13 Aug. 1969 11 p refs
(Contract AT(29-11)-1106)
(RFP-1345) Avail: CFSTI

A group of coaxial water-cooling feedthroughs was designed for use in high vacuum processes. The feedthroughs may be assembled into several configurations, may be insulated for high voltage applications, and have been assembled from readily available components. Author (NSA)

N70-19415# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
COMPUTER-ASSISTED, ADAPTIVELY CONTROLLED MACHINE TOOL SYSTEMS
T. L. Williams 3 Oct. 1969 26 p refs
(Contract W-7405-eng-26)
(Y-1692) Avail: CFSTI

In anticipation of the development of a computer-augmented, adaptively controlled (AC), multiaxis machine tool, a literature search was made to determine the availability of hardware that might be used in such a system and to accumulate pertinent information derived from research directed toward such a system. The results indicate that many advantages can be derived from the development of a computer-augmented (AC) machine tool system. AC will enable a high quality product to be obtained from the fabrication process. NSA

N70-19444*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMIC BEHAVIOR OF AIR LUBRICATED PIVOTED-PAD JOURNAL BEARING-ROTOR SYSTEM. 1: EFFECTS OF MOUNT STIFFNESS AND DAMPING
Zolton N. Nemeth and William J. Anderson Washington Feb. 1970 26 p refs
(NASA-TN-D-5685; E-5273) Avail: CFSTI CSCL 13I

The motion of a vertically mounted rotor in a three-pad tilting-pad gas journal bearing was observed for pressurized operation in air. The bearing pads were 2.02 in. (5.1 cm) in diameter and 1.50 in. (3.8 cm) long. The L/D ratio was 0.75. One pad was mounted on a flexible diaphragm. External pressure ranged from 0 to 100 psig and speeds to 38 500 rpm for diaphragms of two different stiffnesses with and without damping. The amplitude of rotor motion increased with increasing pressure. The stiffer diaphragm produced smaller amplitudes in general. Diaphragm damping was effective in reducing the amplitude of motion only in the direction normal to the diaphragm. Author

N70-19449# California Univ., Livermore. Lawrence Radiation Lab.
LOW-SPEED DIAMOND SAW
E. D. Albrecht, E. H. Stearns, and F. J. Whittmayer 29 Sep. 1969 24 p refs Presented at the 2d Ann. Tech. Meeting of Intern. Metallographic Soc., San Francisco
(UCRL-71611; CONF-690920-4) Avail: CFSTI

A low speed diamond saw was developed for use in cutting experimental and metallographic specimens. A 3-in.-diameter diamond edge blade having a total thickness of 0.006 in. was used. The blade revolved at approximately 200 rpm as opposed to the 2000 rpm generally used in diamond sawing. Various materials including ceramics as well as soft and hard metals were cut. X-ray diffraction patterns revealed less surface disturbance on low speed diamond sawed surfaces than on those produced by spark cutting or high speed diamond sawing. Author (NSA)

N70-19503# Oak Ridge National Lab., Tenn.
TEXTURES OF DRAWN AND PLANETARY SWAGED TUBES OF 0.2 PERCENT Ti TYPE-304L STAINLESS STEEL
T. M. Nilsson Oct. 1969 17 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2682) Avail: CFSTI

Development of texture in the austenitic phase during fabrication of Type 304L stainless steel tubing modified with 0.2% Ti is described. Planetary swaging and mandrel drawing at various reduction schedules were used. Textures developed during fabrication depended on working techniques and reduction schedules, even after small amounts of deformation. Annealing textures were, in general, randomized versions of the deformation textures. In drawing, the component (001) axial direction-(110) radial direction was found after both primarily ironing and primarily sinking reductions. The characteristic feature after planetary swaging was a large number of circumferential (111) planes. Analyses of the fabrication techniques and corresponding texture developments confirm that close-packed directions align parallel to the direction of maximum compression. Author (NSA)

N70-19535# Oak Ridge National Lab., Tenn.
FEASIBILITY STUDY ON REDRAWING TO PRODUCE USABLE TANTALUM TUBING
G. A. Reimann Oct. 1969 16 p
(Contract W-7405-eng-26)
(ORNL-TM-2694) Avail: CFSTI

A procedure was developed to salvage defective tantalum tubing for conversion into a slightly smaller size tubing having acceptable quality. A combination of chemical polishing and mandrel drawing was demonstrated to be a satisfactory procedure. Author (NSA)

N70-19585 National Lending Library for Science and Technology, Boston Spa (England).
EXPLOSION PROTECTION MEASURES ON CANNED MOTOR PUMPS [EXPLOSIONSSCHUTZMASSNAHMEN AN SPALTROHRMOTORPUMPEN]
I. Weyer 10 Sep. 1969 6 p Transl. into ENGLISH from PTB Mitt. (German), v. 79, no. 2, Apr. 1969 p 94-95
(NLL-SMRE-Trans-5749-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Protective measures for canned motor pumps used in chemical processes and reactor technology are described. A description of the necessary steps to be taken in setting up the equipment and a method for protecting the stator compartment are given. A liquid level indicator and a temperature monitoring device are also described. Procedures used in checking the equipment before it is put in operation are included. J.M.C.

N70-19636# Gulf General Atomic, San Diego, Calif.
REPORT ON TEST PROGRAM ON GAS-BEARING COMPRESSOR FOR THE HELIUM PURIFICATION SYSTEM OF THE FORT ST. VRAIN PLANT
G. B. Webb 30 Jun. 1969 60 p
(Contract AT(04-3)-633)
(GAMD-9450) Avail: CFSTI

A regenerative, gas-bearing, motor-driven, hermetically-sealed compressor to circulate helium primary coolant from the reactor through the helium purification system and back to the reactor was tested. The test series included: determination of head-flow characteristic curves, operation in pure helium under various pressure and flow conditions, overspeed test of the impeller, casing hydrostatic pressure test, helium leakage test, start-stop cycling, and transient pressure tests. The compressor and results of the test program are described. NSA

N70-19676# Oak Ridge National Lab., Tenn.
FEASIBILITY STUDY OF REMOTE CUTTING AND WELDING FOR NUCLEAR PLANT MAINTENANCE
Peter P. Holz Nov. 1969 53 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2712) Avail: CFSTI

Activities in a program to adapt the Air Force cut and weld system for orbital vehicles, to remote reactor maintenance, are described. The orbital system includes a carriage, interchangeable

modules for machining or W-arc welding, a weld programmer, and a power supply. Drawings and components for nonnuclear testing have been assembled and operations such as on-pipe carriage clamping, cutting and beveling using one orbital head, changing heads, and welding were completed. Factors related to radioactive system maintenance are discussed. Progress of the feasibility study is summarized. A long range program is proposed for development of a complete remote maintenance system. NSA

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N70-18328# Colorado Univ., Boulder. Dept. of Electrical Engineering.
A 94 GHz MILLIMETER WAVE MASER Annual Report, 1 Jul. 1968 – 31 May 1969
L. O. Hoppie, J. K. Hobbs, R. E. Hayes, and F. S. Barnes Oct. 1969 52 p refs
(Grant NSF GK-1723)
Avail: Issuing Activity

The theoretical, experimental and design work which were done to date in conjunction with the design and construction of a 94 GHz millimeter wave maser is described. Specific areas covered include experimental spectroscopy results on iron doped rutile, a theoretical comparison of two low frequency pumping schemes, and a description of the major components of the final maser system. Author

N70-18377*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARAMAGNETIC ENERGY LEVELS OF THE GROUND STATE OF Cr(+3) IN Al2-03
Robert W. Berwin 15 Jan. 1970 31 p refs
(Contract NAS7-100)
(NASA-CR-107952; JPL-TM-33-440) Avail: CFSTI CSCL 20E

The orbital splitting of the chromium (+3) ion in a host lattice of Al2O3 (ruby) is calculated on the basis of crystalline field theory. Spin-orbit coupling and the Zeeman energy are treated as a perturbation on the orbital singlet ground state in order to derive the spin Hamiltonian. A program has been written for the Univac 1108 computer to diagonalize the spin Hamiltonian matrix. Plots of fine-structure energy levels vs magnetic field are given for theta = 54 degrees 44 minutes and 90 degrees, where theta is the angle between the C axis of ruby and the external dc magnetic field. Author

N70-19000 California Univ., Berkeley.
MODE SWITCHING FOR APPLICATIONS TO TRANSMISSION OF INFORMATION
Gay W. Hong (Ph.D. Thesis) 1968 190 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-10313

Edson's idea of information storage by the use of a multi-frequency oscillator is re-examined for a helium-neon laser system, in which multimode output is common. Information could be conveyed by switching between different mode conbinations in the form of a code. Together with the modulation capability, a secondary goal of conserving total output power is desired. The time required for switching is an important quantity for this system. The modulation aspect is studied by considering the different methods of mode selection for axial modes. Several limitations on switching time were considered. Other mode coupling effects are studied, and an experimental method is found to determine quantitatively the mode coupling coefficients. Internal phase modulation in the AM phase-locked region is also investigated with the original intent of improving the switching time. Dissert. Abstr.

N70-19334# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
POSSIBILITY OF ENHANCED NON LINEAR INTERACTIONS IN A VACUUM USING FOCUSED LASER BEAMS
J. L. Hughes and A. Werner Sep. 1969 14 p refs
(WRE-TN-OSD-109) Avail: CFSTI

Existing quantum-electrodynamic calculations for photon-photon scattering in vacuo do not take into account the coherence properties of laser photons. It is proposed that, due to the high degree of coherence of laser beams, and in the presence of a sufficiently high photon flux, a quasi-collective state is formed within the laser focus volume. This quasi-collective state leads to a considerably enhanced value of the scattering cross-section, compared with values derived from the usual calculations. It is concluded that the scattering of light by light may be within the observable range even with existing laser techniques, and in particular with those described. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 08 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N70-18373# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
SOLIDIFICATION OF IRON BASE ALLOYS AT LARGE DEGREES OF UNDERCOOLING Interim Report, Jan. 1968-Jan. 1969
W. E. Browser, Jr. and M. C. Flemings 15 Jul. 1969 41 p refs
(Contract DAAG46-68-C-0044)
(AD-696562; AMMRC-CR-69-14/1) Avail: CFSTI CSCL 11/6

The report summarizes one of several related research activities on inclusions. The work is primarily on levitation melted and rapidly solidified (including splat-cooled) samples. It deals with effects of solidification variables on (1) dendrite and inclusion structures, (2) influence of high temperature homogenization treatments on inclusions, and (3) influence of inclusions on fracture behavior of iron. The research is an outgrowth of a program on undercooled iron base alloys, that has had important technological, as well as fundamental, findings. Dendrite arm spacing is of major importance in determining properties of castings and of wrought material produced from cast ingots and so determination of the mechanism of establishment of dendrite arm spacing has been of considerable applied as well theoretical interest. Author (TAB)

N70-18378# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AGGREGATE STATE, COMPOSITION, AND STRUCTURE OF THE PRODUCTS OF ELECTRICAL EROSION OF METALS
K. K. Namitokov 9 Sep. 1969 41 p refs Transl. into ENGLISH from Fiz. Osnovy Elektroiskrovoi Obrabotki Materialov, (USSR), 1966 p 88-108
(AD-696315; FTD-MT-24-81-69) Avail: CFSTI CSCL 11/6

The possibility and probability for the formation of particles during erosion either from the liquid or vapor phase is investigated theoretically. The theoretical foundations of the problem are reviewed in detail. The tracks of the erosion particles offer valuable information concerning the state of aggregation, shape, dimensions, and distribution around the discharge center. The analysis of the tracks provided evidence that erosion products are in the liquid and vapor states and the ratio between them may vary. Author (TAB)

N70-18391# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

ANOMALIES OF THE MAGNETIC RESISTANCE IN SEMICONDUCTING COMPOUNDS OF Bi-Sb IN STRONG MAGNETIC FIELDS AT LOW TEMPERATURES

N. B. Brandt et al Apr. 1969 14 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 56, no. 1, 1969 p 65-72 Sponsored by MIT, Lincoln Lab.
(Rept-163-69-373-RULL) Avail: CFSTI

Longitudinal and transverse magnetic resistances of Bi - Sb semiconducting alloys are carried out for Sb in a magnetic field up to 500 Koe and at temperatures from 4.2 to 10 K and for the main orientations of the magnetic field and measuring current relative to the crystallographic axes. Dependences of the transverse and longitudinal resistances on the field strength are qualitatively different when the magnetic field is oriented along the trigonal, binary or bisector axes. The difference may be due to three types of phenomena: to the semiconductor-metal transition, to quasimetallic state, and to the decrease in the carrier concentrations as a result of increasing the gap between the valence band and the conduction band. Author

N70-18431 National Lending Library for Science and Technology, Boston Spa (England).

EFFECT OF TITANIUM AND SULPHUR ADDITIONS ON THE MAGNETIC PROPERTIES OF AN ALNICO ALLOY OF SEMI-COLUMNAR STRUCTURE [WPLW DODATKU TYTANU I SIARKI NA MAGNETYCZNE WLASNOSCI STOPU ALNICO O STRUKTURZE POLKOLUMNOWEJ]

E. Lassocinska et al 21 Aug. 1969 8 p Transl. into ENGLISH from Prace Inst. Hutniczych (Katowice), v. 20, no. 2, 1968 p 97-100 In POLISH and ENGLISH
(NLL-Trans-746-236(9022.40) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The chill casting method was used in trials of casting Alnico Alloys (25% Co) of semi-columnar structure. The following elements were added: titanium in the form of 50% FeTi in proportions varying from .0% to 0.54%, and crystalline sulphur in proportions from .0% to 0.30%. It was found that titanium produced the refinement when the content of Ti increases to 0.54%. In contrast to titanium, the sulphur addition facilitates the oriented crystallization. The columnar crystals grow in thickness and length and under certain conditions exceed even the length of the specimen. The addition of titanium clearly affects the magnetic properties promoting increase in H sub c and at the same time, the loss in B sub r and (BH) sub max. The best magnetic properties in the Alnico alloy of semi-columnar structure were obtained with 0.3% Ti, namely, a considerable increase in H sub c and a slight loss in B sub r and (BH) sub max which corresponds to 2 and 4%, respectively. Sulphur addition to the alloy in amounts up to 0.39% does not affect H sub c, but produces a slight reduction in B sub r and (BH) sub max which at 0.25% sulphur content is as high as 2%. Author

N70-18453# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECTIVENESS OF USING A LOW VACUUM FOR HOT WORKING OF MOLYBDENUM

V. V. Andreeva et al 26 Mar. 1969 10 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabotki Mat., (USSR), no. 2, 1967 p 132-135
(AD-696165; FTD-HT-23-1217-68) Avail: CFSTI CSCL 13/8

The interaction of molybdenum with active gases was studied under conditions of hot working under vacuum and in inert media during the heating, forming, and cooling stages. Conditions for non-oxidizing rolling of Mo were analyzed thermodynamically: the equilibrium pressures in the temperature range of hot working, and the isobaric-isothermal potentials of their formation were calculated. Study of the kinetics of Mo oxidation under different partial pressures corresponding to given vacuums showed oxide film thickness depends on oxygen pressure. Comparison of gas saturation of the Mo after heating in air and under high and low pressure by x-ray examination of cell size of the metalloceramic Mo showed there was no gas saturation of the metal. This was confirmed by microhardness data. The use of low vacuum is recommended in the hot working of metalloceramic bars (8 mm thick). High temperature plastic deformation in low vacuum is apparently also suitable for other metals such as tungsten, rhenium, nickel, and copper. TAB

N70-18455 National Lending Library for Science and Technology, Boston Spa (England).

SOME EXPERIMENTS ON Co-Ni ALLOY BRIGHT PLATING [CO-NI GOKINKEI KOTAKU MEKKI NI OKERU NI SAN NO JIKKEN NI TSUITE]

S. Ehara et al Dec. 1969 8 p refs Transl. into ENGLISH from Kinzoku Hyomen Gijutsu (Tokyo), v. 9, no. 9, 1958 p 334 – 338
(NLL-RTS-5497) Avail: Natl. Lending Library, Boston Spa, Engl: 12s 6d or 2 NLL photocopy coupons

Comparative studies of the properties of the electrodeposits and the working of the plating bath in regards to the various kinds of plating baths of the cobalt-nickel alloy type are made. Results of the measurements of the buffer action of the plating and the hardness of electrodeposits and electron diffraction are presented. For the purpose of the comparison, a bright nickel plating bath containing an organic brightener was found to have good levelling properties. Author

N70-18464# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ACADEMY OF SCIENCES OF THE USSR. INSTITUTE OF METALLURGY. PROPERTIES AND APPLICATION OF REFRACTORY ALLOYS (SELECTED ARTICLES)

N. L. Bamurinskaya et al 4 Sep. 1969 24 p refs Transl. into ENGLISH from Svoistva i Primenenie Zharoprochnykh Splavov (Moscow), 1966 p 153-158 and p 280-285
(AD-696300; FTD-HT-23-312-68) Avail: CFSTI CSCL 11/6

Contents: Hardening of a nickel-base alloy with segregation of a phase with a rhombic lattice; Investigation of the oxidation resistance of alloys of tungsten with niobium and titanium. TAB

N70-18491# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRUCTURE AND PROPERTIES OF THE KHN60MVTYU (EP487) ALLOY

L. N. Zimina et al 5 Sep. 1969 12 p refs Transl. into ENGLISH from Strukt. i Svoistva Zharoprochnykh Metallicheskikh Materialov (Moscow), 1967 p 181-186
(AD-696301; FTD-HT-23-449-68) Avail: CFSTI CSCL 11/6

The structure and properties of the new KhN60MTYu (EP487) heat-resistant, wrought nickel alloy (17-20 percent chromium, 9-11 percent molybdenum, 4-5 percent tungsten, 2.2-2.8 percent titanium, 1.0-1.5 percent aluminum, not more than 6 percent iron and 0.08 percent carbon) has been investigated. The alloy was developed by TsNIIChM jointly with other institutions and is being used for the manufacture of welded articles operating at 750-900 degrees centigrade. The alloy attains its maximum strength after aging at 800-850 degrees centigrade. Its hardness increases rapidly during the first 2-3 hours and then increases insignificantly with holding time increasing up to 25 hours. The microstructure of the alloy, after aging at 800 degrees centigrade for 10 hours, consists of a solid solution with precipitates of the strengthening Gamma-phase at grain boundaries and fairly large inclusions of carbide phases. The optimal mechanical properties of the alloy are obtained after air-quenching from 1100-1130 degrees centigrade and aging at 850 degrees centigrade for 3 hours. Author (TAB)

N70-18517# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHYSICS AND CHEMISTRY OF PROCESSING OF MATERIALS. SELECTED ARTICLES
V. S. Ivanov et al 12 May 1969 40 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabotki Materialov (Russian), No. 1, 1967 p 75-88 and 114-118
(AD-696522; FTD-MT-24-67-69) Avail: CFSTI CSCL 11/6

Contents: Fibrous materials; and Relationship between fine structure and mechanical properties of high-strength steels after low-strength steels after low-temperature thermomechanical treatment with polygonization. TAB

N70-18590# Rensselaer Polytechnic Inst., Troy, N.Y.
DUCTILE TO BRITTLE TRANSITION OF SINGLE PHASE SOLIDS Final Report, 1 Jul. 1966-31 Aug. 1969
Norman S. Stoloff Sep. 1969 16 p refs
(Contract DA-31-124-ARO(D)-468)
(AD-697168; AROD-6339-4-MC) Avail: CFSTI CSCL 11/6

The report presents the results of a study of the role of slip character in the ductile-to-brittle transition of single phase ferrite. FeCo-2%V and Fe-V were used for this study. The report contains an evaluation of the changes in slip character brought about by changes in heat treatment, deformation temperature, solute content, and microstructure. Author (TAB)

N70-18637*† Rocketdyne, Canoga Park, Calif.
EFFECTS OF HIGH PRESSURE HYDROGEN ON METALS AT AMBIENT TEMPERATURE Final Report, 7 Mar. 1967 - 28 Feb. 1969
R. J. Walter and W. T. Chandler 28 Feb. 1969 335 p refs
(Contract NAS8-19)
(NASA-CR-102425; R-7780-1) Avail: CFSTI CSCL 11F

Thirty five alloys were investigated for their susceptibility to high pressure hydrogen environment embrittlement at ambient temperature; subsequently they were ranked according to their reduction of notch strength in 10,000 psi hydrogen. The ranking in order of decreasing embrittlement was as follows: (1) high strength steels and nickel-base alloys; (2) moderate and low strength iron-base alloys, pure nickel, and titanium alloys; (3) nonstable AISI type 300 stainless steels, beryllium-copper, and commercially pure titanium and (4) aluminun alloys, pure copper, and the stable AISI type 300 stainless steels. The degree of hydrogen environment embrittlement was found to increase with increasing hydrogen pressure and to be a complex function of notch severity, passing through a maximum at an intermediate K sub t. Low cycle fatigue properties of low alloy steels were reduced considerably by 1000 and 10,000 psi hydrogen environments. The degree of embrittlement decreased with an increasing yield strength /ultimate strength ratio, providing other variables were constant. Author

N70-18639 National Lending Library for Science and Technology, Boston Spa, (England).
INFLUENCE OF REPEATED STRAIN AGEING UNDER STRESS ON THE MECHANICAL PROPERTIES OF PURE IRON [VLIYANIE MNOGOKRATNOGO DEFORMATSIONNOGO STARENIYA POD NAPRYAZHENIEM NA MEKHANICHESKIE SVOISTVA ZHELEZA]
L. K. Gordienko et al Sep. 1969 11 p refs Transl. into ENGLISH from Fiz. i Khim. Obrabotki Metallov (USSR), no. 1, 1968 p 65-70
(NLL-RTS-5309) Avail: Natl. Lending Library, Boston Spa, Engl.: 15s or 2 NLL photocopy coupons

The structure and ductility of pure iron subjected to repeated warm working are discussed in relation to the conditions of strain aging under no load and under constant stress. The testpieces were taken from plate material with an annealed grain size of about 90 microns. They were subjected to repeated warm working in a special machine capable of applying cycles of tension and compression at varying strain rates. The testpieces were extended at room temperature to the limit of the yield plateau, aged at 423 C, cooled to room temperature and returned for repeated strain cycling. It was found that the aging of pure iron by repeated straining under stress leads to a reduction in the testpiece cross section; a similar effect, though less pronounced, occurs when the testpiece is aged under no load. Holding at temperature under a static load accelerates the strain aging process and promotes an increase in the thermoplastic work-hardening effect of repeated warm working. The maximum effect corresponds to intermediate aging under a stress slightly in excess of the current lower yield point value. Author

N70-18640# Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Material Science
MICROSTRUCTURAL-MECHANICAL PROPERTY RELATIONSHIPS IN HIGH STRENGTH CAST STEELS Interim Report, 1 Jan. 1968-21 Jun. 1969
J. V. Peck, R. B. Bertolo, and J. F. Wallace Watertown, Mass. Army Mater. and Mech. Res. Center Aug. 1969 93 p refs
(Contract DAAG46-68-C-0052)
(AD-696457; AMMRC-CR-69-12/1) Avail: CFSTI CSCL 11/6

The grain refinement of high strength steel castings by small titanium additions has been enhanced by a small particle nucleation technique. The combination of these two mechanisms makes possible the total refinement of large castings inoculated with 0.1% titanium. The fatigue properties of high strength columnar steel castings tested parallel to the chill were found to be influenced by the solidification time (mass effect). Low values of endurance limit and endurance ratio were observed in tests conducted transverse to the solidification direction. Titanium carbonitrides and titanium sulfide inclusions which are by-products of the titanium inoculation exerted little or no influence on fatigue properties although titanium sulfide severely reduced tensile ductility. Utilization of appropriate vacuum melting and casting techniques reduced the volume of non-metallic inclusions. When a sufficiently high thermal gradient is employed during solidification together with proper vacuum melting and casting, the usual loss of ductility with increasing solidification time is markedly reduced. Author (TAB)

N70-18672# Brown Univ., Providence, R.I. Engineering Materials Research Lab.
SHORT-TIME, BIAXIAL CREEP OF AN ALUMINUM ALLOY WITH ABRUPT CHANGES OF TEMPERATURE AND STATE OF STRESSES
Joseph J. Blass and William N. Findley Sep. 1969 47 p refs
(Contract N00014-67-A-0191-0003)
(AD-697142; EMRL-41; TR-5) Avail: CFSTI CSCL 11/6

Short-time, biaxial creep experiments of an aluminum alloy are described which involved abrupt changes in temperature and state of stress. Results are discussed in terms of a creep surface concept similar to the yield surface concept of time-independent plasticity. Evidence that the creep surface changes size, shape, and location in response to creep strain is discussed. The contribution of metallurgical and viscoelastic effects to the complexity of the mechanical behavior are also discussed. Author (TAB)

N70-18722 National Lending Library for Science and Technology, Boston Spa (England).
A MATHEMATICAL MODEL FOR THE FLUID-BED ROASTING OF NICKEL CONVERTER MATTE
V. A. Bryukvin 21 Aug. 1969 12 p refs Transl. into ENGLISH from Sb. Nauchn. Tr., Gos. Nauchn.-Issled. Inst. Tsvet. Metal. (Moscow), no. 21, 1964 p 179-185 In RUSSIAN and ENGLISH
(NLL-Trans-746-257-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A mathematical description is obtained for the roasting process of nickel converter matte in a fluid-bed furnace. A system

of differential equations was derived reflecting the influence of technological parameters on the dynamics of the apparatus. For both models, the influence of process temperature and blast velocity is examined. Author

N70-18746# New York Univ., N.Y. Research Div.
DEVELOPMENT OF IMPROVED TITANIUM ARMOR Final Report
Paul A. Farrar 15 Aug. 1969 20 p refs
(Contract DA-19-066-AMC-267(T))
(AD-697178; AMMRC-CR-69-16) Avail: CFSTI CSCL 19/4

This investigation was undertaken in order to determine the metallurgical factors which affect the ballistic properties of titanium, and to develop base materials with increased ballistic resistance. The use of the dual hardness principle was investigated in an attempt to use the intermetallic compound TiNi as one component in a roll bonded alloy. Author (TAB)

N70-18759# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
REGULATING THE POROUS STRUCTURE OF SPHERICAL ALUMINUM OXIDE. THE EFFECT OF GELATIN ADDITIVES ON THE TEXTURE OF ACTIVE ALUMINUM OXIDE [REGULARISATION DE LA POROSITE DE LA STRUCTURE DE GRAIN D'ALUMINE. INFLUENCE DE L'ADDITION DE GELATINE SUR LA TEXTURE DE L'ALUMINE ACTE]
N. F. Yermolenko et al [1969] 9 p REFS Transl. into FRENCH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 12, no. 6, 1968 p 527–529 In FRENCH and RUSSIAN
(LRBA-69-0519) Avail: CFSTI

It was previously demonstrated that uniform porous powdered aluminum oxide can be obtained by adding aqueous solutions of gelatin during precipitation of the hydroxide. It is shown that the porous structure of spherical aluminum oxide can be regulated by adding aqueous solutions of gelatin to the forming mass. The addition of gelatin enhances formation of smaller pores in the oxide and substantially increases the specific surface when compared to the original specimen. Transl. by R.B.

N70-18775# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BRITTLENESS AND PLASTICITY OF HEAT-RESISTANT MATERIALS
A. V. Stanyukovich 10 Jul. 1969 18 p refs Transl. into ENGLISH from Izd-Vo'Met., (Moscow), 1967 p 199
(AD-696280; FTD-MT-24-464-68) Avail: CFSTI CSCL 11/6

The book deals with the causes of brittle failure of parts working at high temperatures and also with certain factors leading to such failures and their development (for instance: heat treatment, material structure, strain hardening, direction of fiber in rolled metal, welding conditions and stresses). Methods of determining the susceptibility of steels and alloys to embrittlement at high temperatures are described. Data on the deformation capacity under various conditions of the principal heat-resistant steels and alloys used in power machinery are presented. Author (TAB)

N70-18777# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
X-RAY SPECTRAL INVESTIGATION OF THE ELECTRON STRUCTURE OF IRON-ALUMINUM ALLOYS
V. V. Nemoshkalenko et al Apr. 1969 17 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 13, no. 9 1958 p 1431–1439 Sponsored by MIT, Lincoln Lab.
(Rept-166-69-377-RULL) Avail: CFSTI

The form, energy position, relative peak and integral intensities of AlK beta sub x - and FeK beta sub 5 - bands were investigated. The K alpha sub 4,' K alpha sub 3 intensity ratio and energy position of K alpha sub 4 - and K alpha sub 3-satellite lines were obtained. Comparison of the data obtained with the results of the investigation of FeL(111)-band and with data of other physical experimental methods testifies to the transfer of a certain part of the high-energy electrons of aluminum atoms to the orbitals of iron atoms within the range of concentration up to 25 at.% Al. At concentrations above 26 at.% Al, coupling of d-electrons with the d-quasiband takes place without change in their statistical weight. Author

N70-18884# Army Foreign Science and Technology Center, Washington, D.C.
SIMULATION OF A POROUS BODY AND THE DETERMINATION OF RELATIVE CROSS SECTIONAL WEAKING BY THE PORES
I. M. Storozhevskii 6 Nov. 1969 14 p refs Transl. into ENGLISH from Poroshkovaya Met., (USSR), v. 5, no. 11, 1965 p 70-75
(AD-697327; FSTC-HT-23-245-70) Avail: CFSTI CSCL 11/6

Possible models of a porous body are considered on the assumption that sintered material may have the form of figures of the same shape completely filling a space. Formulae are proposed for estimating the relative weakening of the cross section of the pores depending on the shape of the pores and models. Author (TAB)

N70-18940*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
INFLUENCE OF SALT AND ELEVATED-TEMPERATURE EXPOSURE ON THE MAXIMUM COMPRESSIVE STRENGTH OF TITANIUM-ALLOY SKIN-STRINGER PANELS
James E. Gardner and Dick M. Royster Washington Feb. 1970 34 p refs
(NASA-TN-D-5670; L-6742) Avail: CFSTI CSCL 11F

Panels were fabricated from a Ti-8Al-1Mo-1V titanium alloy by riveting, resistance- and arc-spotwelding, tungsten inert gas fusion welding, and diffusion bonding. One group of panels was tested to failure at room temperature after being coated with a 3.4 percent NaCl solution and exposed at 600 F (590 K) for 1000 hours to develop and grow corrosion cracks. The other group was tested to failure after being heated to 600 F (590 K) from the skin side by a quartz lamp radiator. Strengths at maximum load were compared to assess the joining techniques, and the results of this study were compared with room temperature results of a previous study and with results of an existing compressive strength analysis. Hot salt-stress corrosion cracks had little effect on panel strength although considerable tearing and deformation at maximum load appeared to initiate from the cracks. The maximum strengths of the panels tested at elevated temperatures showed little variation (approximately 11 percent) and were consistently lower than the strengths obtained in previous room temperature tests. These reduced strengths resulted from reductions in material properties at elevated temperature and not from thermal stresses. The magnitude of the maximum strengths of the panels was reasonably predicted by the local-crippling compressive strength analysis. Author

N70-18961*# Tyco Labs.,Inc., Waltham, Mass.
LEAD TELLURIDE BONDING AND SEGMENTATION STUDY Semiannual Phase Report, 1 Feb. – 31 Jul. 1969
H. E. Bates, S. Mermelstein, S. Michalik, and F. Wald 31 Jul. 1969 78 p refs
(Contract NAS5-9149)
(NASA-CR-108174; SAR-4) Avail: CFSTI CSCL 11F

This report discusses studies of the Co-Si-Ge system in some detail and also presents results on the Pd-Ge system. Furthermore, a summary of all life test results on tungsten diffusion bonded lead-telluride is given together with an explanation of the bonding process and a detailed description of the bonding cycle. Progress in the construction of cesium plasma lamps as high temperature heaters is reviewed. Finally, a major part of this report deals with the progress achieved in the design and construction of the segmented submodules already described in previous reports. Author

N70-18962*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EVALUATION OF TUNGSTEN ALLOY FIBER/NICKEL-BASE ALLOY COMPOSITES FOR TURBOJET ENGINE APPLICATIONS
Donald W. Petrasek and Robert A. Signorelli Washington Feb. 1970 27 p refs
(NASA-TN-D-5575; E-5252) Avail: CFSTI CSCL 11F

The potential of tungsten-2-percent thoria, tungsten-5-percent rhenium-2 percent thoria, 218 CS tungsten, and tungsten-1-percent thoria wire-reinforced nickel-base superalloy composites for turbine bucket applications was evaluated on the basis of stress-rupture strength and oxidation and impact resistance. The results indicated that refractory metal alloy fiber - superalloy composites are potentially useful for turbine bucket applications on the basis of the properties measured. The 100- and 1000-hr stress-rupture strengths of the composite at 2000 F were 49 000 psi and 37 000 psi, respectively. A few thousands of an inch of matrix or cladding material protected the fibers from oxidation at 2000 F. At 300 F and above, the impact resistance of the composite compared favorably with that of superalloys. Author

N70-19015 National Lending Library for Science and Technology, Boston Spa (England).
CORROSION CRACKING OF HIGH STRENGTH STEELS [KORROZIONNOE RASTRESKIVANIE VYSOKOPROCHNYKH KONSTRUKTSIONNYKH STALEI]
F. F. Azhogin 2 Sep. 1969 12 p refs Transl. into ENGLISH from Fiz.-Khim. Mekhan. Materialov (USSR), v. 3, no. 3, 1967 p 273-281
(NLL-LC-1482-(5196) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupons

High-strength structural steels of martensitic structure, with high mechanical properties, are characterised by a great sensitivity to the action of the external medium. On simultaneous action of tensile stresses and a number of corrosion-active media, high-strength steels tend to undergo corrosion cracking, which can take place at stresses below the yield point. This type of corrosion failure is also peculiar to aluminum, magnesium and copper alloys, and mild and stainless steels. In determining the mechanism of corrosion cracking, great importance attaches to evaluation of the effect of the tensile stresses on the corrosion rate. On corrosion with hydrogen and oxygen depolarisation, the corrosion rate of steel increases on increase in the tensile stresses, the relationship between the corrosion rate and the stress being close to linear. It is also impossible to associate the observed increase in the corrosion rate of steel with the mechano-chemical effect, since the magnitude of the tensile stresses at which the corrosion rate of the steel was determined was far below the yield point and the plastic deformation of the steel. Author

N70-19073# Battis Atomic Power Lab., Pittsburgh, Pa.
CRITICAL ANGLE ULTRASONIC TECHNIQUE FOR DETECTING HYDRIDES IN ZIRCALOY
H. J. Willard, Jr. Oct. 1969 26 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-833) Avail: CFSTI

A feasibility study of a critical angle ultrasonic technique for detecting hydrides in Zircaloy was conducted. A focused ultrasonic beam incident on the surface of the specimen at the Rayleigh critical angle is used. The amplitude distribution of the reflected beam is very sensitive to the density and elastic properties of the specimen, both of which are altered by the presence of hydrides. Measurements were made at 1, 2.25, and 5 MHz in 0.140-inch-thick Zircaloy flat plate specimens of 0, 300, and 600 ppM nominal hydrogen content. For this work the sensitivity of the technique was 600 ppM and appeared to be limited by the surface preparation of the sample. Author (NSA)

N70-19098 Case Western Reserve Univ., Cleveland, Ohio.
MECHANISMS OF STRENGTHENING AND RECRYSTALLIZATION IN DISPERSION HARDENED ALLOYS
Gordon Stanley Doble (Ph.D. Thesis) 1968 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-9448

The elevated temperature tensil properties of TD Nickel were measured after mechanical working and recrystalization treatments. Increases in strength were produced by cold swaging while upset forging or prior torsion lowered the strength. Recrystallization to a coarse grain size increased strength over the fine grained cold worked bar stock. Activation energies, measured at 3000 F under tensile conditions, ranged from 160 to 330 K-cal/mol for both fine grained cold worked or coarse grained recrystallized structures. Intercrystalline cracking was the controlling mechanism for elevated temperature strength of recrystallized TD Nickel. Evidence for a similar mechanism in fine grained TD Nickel is discussed. The development of a recrystallization resistent structure in TD Nickel was shown to depend upon the deformation history. Dissert. Abstr.

N70-19104# Atomic Energy of Canada, Ltd., Chalk River, (Ontario). Applied Materials Research Branch.
A REVIEW OF HIGH STRENGTH ZIRCONIUM ALLOYS
C. D. Williams Oct. 1969 42 p refs
(AECL-3456) Avail: CFSTI

A demand exists for a neutron-economical pressure tube alloy which can operate at a temperature in excess of 400 C. Here a review is made of literature covering work on zirconium alloys having strengths generally higher than the conventional zirconium-based pressure tube alloys. Examination of this information and assessment of the composition and properties of successful high strength titanium alloys indicates that zirconium-based alloys having superior mechanical properties to those developed to date, and also having acceptable neutron capture cross-section, can be produced by conventional alloying methods. Author

N70-19120 National Lending Library for Science and Technology, Boston Spa (England).
HOMOGENEITY OF CARBONYL IRON-NICKEL POWDERS
L. D. Konchakovskaya et al 21 Aug. 1969 12 p refs Transl. into ENGLISH from Porosh Met. (Russian), v. 8, no. 10, Oct. 1968 p 5-10 In RUSSIAN and ENGLISH
(NLL-Trans-746-235-(9022.40)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Histograms are plotted for concentration distributions in iron-nickel powders obtained by joint decomposition of carbonyls. Considerable homogenization of the powders is found after annealing at low temperatures. The powder particles lose their bulbous structure after low-temperature annealing. Author

N70-19123# National Research Council of Canada, Ottawa (Ontario).
THE EXAMINATION OF ETCHED NIOBIUM AND NIOBIUM ALLOYS IN POLARIZED LIGHT
J. M. Trenouth (Natl. Aeron. Estab.) and M. S. Grzedzielski (Natl. Aeron. Estab.) Jun. 1969 19 p refs
(NRC-11030; MS-124) Avail: CFSTI

Although optically isotropic, niobium and the niobium alloys B66 and FS85 can be made to respond to polarized light by a suitable etching treatment. The etching technique and possible uses of the ensuing activity in polarized light are described. Evidence that the activity of such isotropic metals is due to the surface topography is presented. The surface structure and its crystallographic relation are discussed with particular reference to similar observations on fcc metals. Author

N70-19126*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
MASS SPECTROMETRIC INVESTIGATION OF

VAPORIZATION THERMODYNAMICS OF YTTRIUM DICARBIDE-CARBON SYSTEM AND DISSOCIATION ENERGY OF YTTRIUM DICARBIDE AND TETRACARBIDE
Fred J. Kohl and Carl A. Stearns Washington Feb. 1970 27 p refs
(NASA-TN-D-5646; E-5396) Avail: CFSTI CSCL 07C

The Knudsen effusion method was used in conjunction with a double focusing mass spectrometer to study the vaporization of the yttrium dicarbide-carbon system. Over the temperature range from 2270 to 2550 K the vapor pressures for yttrium, yttrium dicarbide, and yttrium tetracarbide were measured. Experimentally determined enthalpies were combined with published thermodynamic data to yield the atomization energies of yttrium dicarbide and yttrium tetracarbide molecules. The heat of formation of solid yttrium dicarbide was also calculated. Author

N70-19176*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMOMECHANICAL PROCESSING OF MOLYBDENUM-HAFNIUM-CARBON ALLOYS
Peter L. Raffo Washington Feb. 1970 47 p refs
(NASA-TN-D-5645; E-5297) Avail: CFSTI CSCL 11F

A study was made of the thermochemical processing of a series of Mo-Hf-C alloys. The processes either produced an overaged carbide precipitate within a strain hardened matrix or allowed the formation of a finer precipitate during fabrication by a dynamic strain aging reaction. The short time tensile properties of the strain aged alloys were superior to those of any other molybdenum alloy studied to date. Author

N70-19254 National Lending Library for Science and Technology, Boston Spa (England).
HIGH-TEMPERATURE CORROSION OF IRON, NICKEL, CHROMIUM, NICKEL-CHROMIUM, AND NICKEL-IRON 20% CHROMIUM ALLOYS DUE TO VANADIUM PENTOXIDE AND HYDROGEN SULPHIDE
W. Spyra 24 Sep. 1969 14 p refs Transl. into ENGLISH from D.E.W. Tech. Berichte (German), v. 8, no. 2, 1968 p 52–58 (NLL-CE-Trans-5172-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The high-temperature corrosion caused by V2O5 at 925 C and by H2S at 625 C on iron, nickel, chromium, nickel-chromium alloys, iron-chromium alloys of up to 50% Cr content and 20% Cr nickel-iron-chromium alloys is studied. Of the tested metals the resistance to corrosion through V2O5 increases from metal to metal in the order iron-nickel-chromium. Compared with nickel and iron metal, Cr contents of up to 15% intensify the V2O5 corrosion attack on nickel-chromium and iron-chromium alloys. Relatively resistant to V2O5 are nickel-chromium alloys containing upwards of 60% Cr and iron-chromium alloys of more than 30% Cr content. Most resistant among the nickel-iron-20% chromium alloys are materials containing about 15 to 20% Fe. Their corrosion resistance is comparable to that of nickel-chromium alloys of about 60% Cr content and they probably have much better mechanical properties. V2O5 high-temperature corrosion attack is supposed to be a type of catalytically accelerated oxygen corrosion in the course of which the liquid corrosive agent reacts with the surface oxide films to vanadates, so that the protective faculties of the oxides are lost. Author

N70-19255# Radio Corp. of America, Princeton, N.J.
IMPROVED COMPATIBLE MATERIALS FOR THERMOELECTRIC POWER GENERATION Final Report
J. P. Dismukes, I. Kudman, and H. I. Moss Aug. 1969 40 p refs
(Contract AT(30-1)-3886)
(NYO-3886-4) Avail: CFSTI

During this period, the major effort of research on PbTe alloys was concentrated on improving hot-pressing procedures so that multi-sample pressing would reproducibly provide desired thermoelectric properties, and on extensive life-testing of the multi-sample hot-pressed material. In addition, in-gradient life tests, high-temperature thermoelectric measurements, and thermocouple efficiency measurements were carried out. As a result of a comprehensive series of experiments, the problems previously observed with hot-pressed material were eliminated. Samples of both n-type PbTe-GeTe alloys and p-type PbTe-PbSe alloys can now be reproducibly hot-pressed with a figure-of-merit over the entire temperature range of 25 to 525 C, essentially equivalent to that of melt-grown material. Author (NSA)

N70-19277# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
FORMATION OF SOLID SOLUTIONS OF THE METALS OF 2B WITH BORON, AND THE DEFORMATION MECHANISMS, DISLOCATIONS, AND TWINNING IN BORON
C. E. Holcombe 24 Oct. 1969 41 p refs
(Contract W-7405-Eng-26)
(Y-1691) Avail: CFSTI

By the formation of a solid solution of zinc in boron, it was possible to observe internal structures in boron deformed by autoclaving. Interaction of slip systems, cleavage cracks, dislocation and slip-plane pileup, accommodation bands, annealing twins, low-angle subgrains from dislocation interaction, and primary recrystallized subgrains were found to occur in boron. Mechanical twinning was not observed. Author (NSA)

N70-19287# California Univ., Los Angeles. School of Engineering and Applied Science.
RELATION BETWEEN K SUB Ic AND MICROSCOPIC STRENGTH FOR LOW ALLOY STEELS
Joel Malkin (CEA) and Alan S. Tetelman 1 Oct. 1969 41 p refs
(Contract DAHC04-68-C-0008)
(AD-697145; TR-1; AROD-8016-1-MC; Rept-69-58) Avail: CFSTI CSCL 11/6

A simple model was developed to determine K sub Ic in terms of the microscopic cleavage strength and the tensile yield strength for low temperature cleavage fracture in A302 B and A533 reactor grade quenched and tempered steels. The model applies at sufficiently low temperatures or in irradiated steels. It was determined that microscopic cleavage strength is independent of temperature below −150 F and then increases with increasing temperature, and is apparently independent of irradiation. At temperatures above that at which microscopic cleavage strength is equal to or less than 3.4 of tensile yield strength, unstable fracture initiates when a critical plastic strain is achieved near to the crack tip. The critical local plastic strain for unstable fracture also increases with increasing temperature. Author (TAB)

N70-19305# Michigan Technological Univ., Houghton. Dept. of Metallurgical Engineering.
EFFECT OF ANNEALING ON THE SUBSTRUCTURE OF COLD WORKED fcc METALS AND ALLOYS Technical Progress Report, 1 Sep. 1968–1 Sep. 1969
D. E. Mikkola, D. J. Borich, and M. Sakai 1 Sep. 1969 25 p refs
(Contract AT(11-1)-1431)
(COO-1431-7; TPR-5) Avail: CFSTI

Research on relations between the structures and properties of metals and alloys is summarized. The observed changes in substructures as shown by X-ray diffraction and transmission electron microscopy are analyzed in terms of physical properties. Materials studied during the report period include Cu–Ge solid solutions, and the intermetallic Cu3Au, Ni3Al, and Pt3Co compounds. NSA

N70-19339# Union Carbide Corp., Oak Ridge, Tenn.
HOMOGENIZATION EVALUATION OF A CAST URANIUM-MOLYBDENUM ALLOY
C. P. Coughlen, P. A. Evans, and A. B. Townsend 6 Oct. 1969 17 p refs
(Contract W-7405-Eng-26)
(Y-1696) Avail: CFSTI

Studies have been made on the uranium-10 weight percent molybdenum alloy to determine the method and parameters of heat treatment for homogenization, the method and results of tensile testing the treated alloy, and the results of metallography performed on the material. In addition, metallography was performed on stock from the wrought alloy which demonstrated lack of homogeneity. Author (NSA)

N70-19352*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
DIFFUSION OF NICKEL AND INDIUM ALONG GRAIN BOUNDARIES IN IRON [DIFFUZIYA NIKELYA I INDIYA PO GRANITSAM ZEREN V ZHELEZE]
M. A. Krishtal et al Washington NASA Jan. 1970 8 p refs Transl. into ENGLISH from Zashch. Pokrytiya na Metallakh (USSR), no. 2, 1968 p 209-216
(Contract NASw-1692)
(NASA-TT-F-12807) Avail: CFSTI CSCL 11F

The effect of impurities on the diffusion mobility of nickel along the grain boundaries of iron as well as the mechanism of boundary diffusion of both soluble and insoluble elements in the crystal lattice of iron (nickel and indium, respectively) were studied. Increased impurities were found to improve boundary diffusion of nickel into technical grade iron in the experiments; this is attributed to a cancelling out of the effects of impurities on the activation energy of diffusion, which did not occur in the case of electrolytically pure iron. Indium, on the other hand, produces dislocations in the iron lattice. Author

N70-19357# Idaho Nuclear Corp., Idaho Falls.
COMPATIBILITY STUDY OF COMMON THERMOCOUPLE MATERIALS WITH FHUST ZIRCALOY-CLAD HEATERS
T. J. Mc Grath and D. E. Williams Sep. 1969 18 p ref
(Contract AT(10-1)-1230)
(IN-1307) Avail: CFSTI

A series of scoping studies, to aid in the development of techniques for bonding thermocouples to the Zircaloy-clad heaters used in the FHUST program, was performed to determine the compatibility and life of common thermocouple materials with Zircaloy. The bonding techniques were required to meet the following criteria: (a) preclude eutectic formation between the metals used in the thermocouple construction and the Zircaloy heater cladding, (b) withstand the oxidation produced by a steam atmosphere, (c) not deteriorate in environments of vacuum or inert gas, and (d) have a minimum life of ten tests at a temperature of 2200 F for several minutes duration. Author (NSA)

N70-19388# Reactive Metals, Inc., Ashtabula, Ohio.
[UPSET FORGING OF ALLOY 801, DOUBLE FORGING, AND EXTRUSION] Semiannual Progress Summary, Jan.-Jun. 1969
R. L. Bean 26 Sep. 1969 58 p
(Contract AT-(30-1)-1405)
(RMI-13) Avail: CFSTI

Research and development progress are reported on upset forging of Alloy 801 and on double forging to reclaim faulty billets. Other work is reported on fabrication of internally and externally cooled elements by extrusion and or oxidation of U to prevent galling during extrusion. Information is also included on improved extrusion lubrication, development of methods for promoting duplexed grain structure in extruded Mark 30 overstock, and on precision extrusion processes for Mark 30 geometries. Author (NSA)

N70-19402# Union Carbide Corp., Oak Ridge, Tenn.
A STUDY OF THE TIME-TEMPERATURE TRANSFORMATION BEHAVIOR OF A URANIUM-7.5 WEIGHT PER CENT NIOBIUM-2.5 WEIGHT PER CENT ZIRCONIUM ALLOY ZIRCONIUM ALLOY
C. W. Dean (M.S. Thesis - Tenn. Univ., Knoxville) 24 Oct. 1969 101 p refs
(Contract W-7405-eng-26)
(Y-1694) Avail: CFSTI

The time-temperature transformation behavior of the gamma phase of a uranium-7.5 weight per cent niobium-2.5 weight per cent zirconium alloy was determined for the temperature range from 200 to 800 C. Metallography, microhardness, and X-ray diffraction techniques were used to determine a time-temperature transformation diagram. The diagram was found to consist of two overlapping C curves. The morphology of the transformation was: a lamellar structure above the upper nose, a fine precipitation of alpha-uranium platelets below this nose, and a Widmanstatten pattern which has its time-temperature relationship defined by the lower nose. The critical temperature was determined to be 650 C. Above this temperature the body-centered cubic gamma phase was stable. Upon water quenching to room temperature, a transition phase, meson(s), was formed in which the body-centered atoms are slightly shifted. Upon aging, this phase transformed to gamma meson (0), which is tetragonal. Author (NSA)

N70-19427# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
NATURE OF AGING OF Fe-Cr-Al-Y ALLOYS AT 450 C
J. L. Bartos 16 Jul. 1969 12 p refs
(Contract AT(40-1)-2847)
(GEMP-708) Avail: CFSTI

When Fe-Cr-Al-Y alloys containing 15 wt percent chromium or more are aged at 450 C, a chromium-rich ferrite, denoted alpha', is precipitated The presence of aluminum and yttrium changes the distribution of alpha' from the very fine, uniform precipitate found in binary iron-chromium alloys to a grain boundary phase in Fe-Cr-Al-Y alloys. The presence of alpha' has a deleterious effect on the slow bend ductility of these alloys. Aging for 1000 hours at 450 C raises the ductile-to-brittle transition temperature 75 to 100 C. The addition of molybdenum promotes alpha' precipitation, but the resulting alpha' overages after approximately 250 hours at 450 C. Author (NSA)

N70-19430# Virginia Polytechnic Inst., Blacksburg.
MAGNETIC PROPERTIES OF BINARY RARE EARTH ALLOYS
Arthur Holmes Millhouse (Ph.D. Thesis) Sep. 1969 135 p refs Sponsored in part by AEC
(TID-25248) Avail: CFSTI

Single-crystal samples of Ho-Dy, Er-Gd, Er-Tb, Er-Dy, and Ho-Er alloys were prepared using the strain-anneal technique. Neutron diffraction studies of these samples were made from room temperature to 4.2 K to determine their magnetic structure properties. In most cases, a detailed study of the intensities of several important reflections were made as a function of temperature. The temperature dependence of the ordered atomic moment and its projections along the c axis and upon the crystal basal plane were calculated, using the magnetic structure models proposed for the pure metals. For the alloys, these models are found to be satisfactory. In the alloy systems Er-Tb, Er-Dy, and Ho-Er, the best agreement with the measured moment values is obtained by assuming that the Tb, Dy, or Ho moments are parallel to the Er moments within hexagonal layers at 4.2 K. Author (NSA)

N70-19434# California Univ., Livermore. Lawrence Radiation Lab.
IMPROVEMENTS IN HOT MICRO-HARDNESS TESTING TO 1500 DEG C

R. L. Landingham 2 Sep. 1969 47 p refs Presented at the 2d Ann. Tech. Meeting of Intern. Metallographic Soc., San Francisco
(UCRL-71862; Conf-690920-2) Avail: CFSTI

Dispersion-strengthened refractory metals were prepared by chemical covapor deposition and internal nitriding to improve their creep resistance. Preliminary screening of these materials by hot microhardness tests significantly reduced the number of costly creep test facilities and specimens. Hot microhardness values were correlated with amount, size, and distribution of the dispersoids in screening these materials. Several modifications in the commercially acquired hot microhardness tester were made during these screening tests to improve the precision of results. The modifications of the specimen holder, furnace, indenter rate controller, and vacuum system are described. The existing optical system was not modified since it met the needs of viewing and photographing the indentations up to 1500 C in vacuum. Difficulties above 1500 C are also discussed. Author (NSA)

N70-19435*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
INFLUENCE OF ALLOYING ELEMENTS ON THE DISLOCATION STRUCTURE OF CHROMIUM [VLIYANIYE LEGIRUYUSHCHIKH ELEMENTOV NA DISLOKATSIONNUYU STRUKTURU KHROMA]
G. G. Kurdyumova et al Washington NASA Feb. 1970 15 p refs Transl. into ENGLISH from Fiz. Priroda Plast. Deformatsii i Razrusheniya Metallov (Kiev), 1969 p 24-37
(Contract NASw-1692)
(NASA-TT-F-12819) Avail: CFSTI CSCL 11F

A study is made of the effect of a series of elements from groups 7A and 8 on the dislocation structure and mechanical properties of chromium. It is shown that these elements essentially modify the electron and dislocation structure of chromium alloys, influencing the ductile-brittle transition temperature. The results obtained are discussed in terms of the electron and dislocation theories of metal structure. Author

N70-19448# Institute of Nuclear Research, Warsaw (Poland).
DIFFUSIVE SULPHURATION OF STEEL WWN1 USED FOR MATRIXES WORKING IN INCREASED TEMPERATURES
Tadeusz Kochanski 1968 16 p refs In POLISH
(INR-1049) Avail: AEC Depository Libraries

The sulfurization of steel WWN1 used for matrixes for cladding fuel elements was done to increase immunity against wear of rubbing surfaces. The results of metallographic observations, hardness measurements, and immunity are described. Author (NSA)

N70-19479# Maryland Univ., College Park.
AN INVESTIGATION OF IRRADIATION STRENGTHENING OF bcc METALS AND SOLID SOLUTIONS Progress Report, Jan.-Oct. 1969
Oct. 1969 72 p refs
(Contract AT(40-1)-3612)
(ORO-3612-6) Avail: CFSTI

Investigations of changes in metal dislocation dynamics caused by neutron irradiation are reported. Information is included on the effects of neutron irradiation and oxygen interstitials on dislocations in V and on strain dependence of the activation volume in irradiated V. Other work is reported on methods of producing high-purity V. Discussions are included on relations between dislocation velocity and macroscopic deformation in bcc metals and on radiation strengthening of copper single crystals. NSA

N70-19489# Oak Ridge National Lab., Tenn.
DEVELOPMENT OF ELECTROLESS NICKEL COATING FOR HIGH PERFORMANCE ALUMINUM FUEL PLATES
R. D. Cheverton, J. C. Griess, and J. R. Mc Guffey 13 Aug. 1969 23 p refs Sponsored by AEC
(ORNL-TM-2642) Avail: CFSTI

There is a limit to the applicability of aluminum as a fuel cladding and matrix material in high performance water cooled research reactors. One approach to extending the usefulness of aluminum is to deposit a corrosion resistant, electroless nickel coating on the surface of the fuel plates. An investigation using specimens coated with nickel by a new technique revealed that as-plated samples successfully withstood bend, thermal shock, and autoclave and dynamic corrosion tests without cracking, measurable corrosion, or sloughing. In one additional dynamic corrosion test a tubular specimen was electrically heated so as to provide a high heat flux through the nickel coating; small cracks developed, but there was no sloughing of the nickel. Following these tests on ORR fuel element was partially coated with nickel so as to introduce the effects of radiation. After ten weeks of normal operation, the nickel coating appeared to be in excellent condition. The tests were conducted in deionized water. A few out-of-pile tests were also conducted in pH 5 (HNO_3) water, and the results indicated an excessively high corrosion rate of the nickel. Author (NSA)

N70-19495# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
NEUTRON DAMAGE IN MOLYBDENUM IRRADIATED AT HIGH TEMPERATURES
R. C. Rau, F. Secco d'Aragona, and R. L. Ladd Sep. 1969 20 p refs
(Contract AT(40-1)-2847)
(GEMP-706) Avail: CFSTI

Transmission electron microscopy has been used to characterize the microstructure of polycrystalline molybdenum irradiated at elevated temperatures. Irradiation at 700 C produced dislocation loops within the grains and denuded zones along grain boundaries, while irradiation at 1000 C resulted in generally loop-free grains which occasionally contain bands of loops and dislocation debris parallel to grain boundaries. Diffraction contrast analyses showed that most of the loops are interstitial edge type. Irradiation at these temperatures also produced small voids which were interpreted as representing aggregates of radioinduced vacancies. Author (NSA)

N70-19501# California Univ., Livermore. Lawrence Radiation Lab.
FURTHER STUDIES ON IRRADIATED LITHIUM HYDRIDE: METAL FORMATION AND THERMAL ANNEALING BEHAVIOR
P. C. Souers, T. S. Blake, R. M. Penpraze, and H. R. Leider 6 Aug. 1969 9 p refs Sponsored by AEC
(UCRL-50726) Avail: CFSTI

An empirical scale of size for aggregates of lithium metal in irradiated LiH was established using the results of nuclear magnetic resonance and X-ray studies. Some property changes that result from thermal annealing of irradiated LiH are also described. Author (NSA)

N70-19510# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
FORMATION OF CORROSION-RESISTANT OXIDE FILM ON URANIUM
G. S. Petit, R. R. Wright, C. A. Kienberger, and C. W. Weber 13 Oct. 1969 26 p refs
(Contract W-7405-eng-26)
(K-1778) Avail: CFSTI

A vacuum heat-treatment method has been developed for coating uranium metal with a protective uranium oxide film. No corrosion was observed on coated uranium coupons after they were exposed for several hundred hours in a corrosion test bath at 95 C and 100% relative humidity. The metallic uranium was coated by vacuum heat treatment at 625 C, using a controlled amount of oxygen. Varying the amount of oxygen added to the furnace provided control of film thicknesses in the range from 0.0002 to

0.001 in. The hard, blue film was nonwetting and very adherent; it had a surface finish equivalent to that on the original uranium metal. Author (NSA)

N70-19516# Stockholm Univ. (Sweden). Inst. of Inorganic and Physical Chemistry.
X-RAY STUDIES ON BINARY ALLOYS OF ALUMINUM WITH PLATINUM METALS
Lars-Erik Edshammar 1969 51 p refs
(NP-18014) Avail: CFSTI

Crystal structure studies of the platinum metal aluminides, previously reported in nine papers, are summarized and discussed. The discussion also includes several related compounds, including other transition metal aluminides. Intermediate phases in the systems and the crystal chemistry of the aluminides are surveyed. The bonding in the platinum metal aluminides is discussed. NSA

N70-19524# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
CRYOGENIC MECHANICAL PROPERTIES OF IRRADIATED ALLOYS
J. R. Coombe and R. P. Shogan Aug. 1969 18 p refs
Submitted for publication
(WANL-TME-1943) Avail: CFSTI

Development of the Nuclear Engine for Rocket Vehicle Application (NERVA) requires that the combined effects of nuclear radiation, temperature, and stress be considered. The NERVA reactor design requirements for material in this application of nuclear power to propulsion for extra terrestrial missions include temperatures from 40 to 5000 R in combination with high levels of nuclear radiation. Experimental programs have been conducted to evaluate materials and generate design data. The materials tested were hot pressed block beryllium, titanium-5% aluminum-2.5% tin ELI (A110AT), and an aluminum alloy 2219. Some of the liquid nitrogen irradiated and tested material data as well as room temperature data are presented. The effects of temperature on radiation characteristics and subsequent material properties after cryogenic temperature irradiation are discussed. The properties investigated have included ultimate tensile strength, 0.2% offset tensile and compressive yield strength, percent elongation, and fracture toughness. Author (NSA)

N70-19541# Union Carbide Nuclear Co., Oak Ridge, Tenn.
ELECTROLESS NICKEL PLATING FOR CORROSION PROTECTION OF URANIUM
G. S. Petiti, R. R. Wright, C. A. Kienberger, and C. W. Weber 13 Oct. 1969 29 p refs
(Contract W-7405-eng-26)
(K-1777) Avail: CFSTI

Two electroless nickel plating methods have been developed for corrosion protection of metallic uranium. In one method, the uranium is heat-treated in a vacuum furnace and given an electrostrike in a nickel sulfamate bath to initiate the electroless plating process prior to placing it in the standard high-temperature electroless plating bath. In the second method, the plating is done in a low-temperature electroless bath, initiated by making the uranium cathodic for a few seconds. The nickel-plated uranium from either bath is heat-treated in a vacuum furnace to form a uranium-nickel alloy at the interface. Metallic uranium pieces varying in area from 7 sq in to 17 sq ft have been plated with nickel in the standard high-temperature electroless plating bath. Nickel deposits ranging in thickness from 0.0005 to 0.002 in. were readily plated with the thickness controlled to within + or - 0.0002 in. There was no porosity in the deposit and no peel-back of a freshly cut edge after 165 hr in a steam test bath. Author (NSA)

N70-19547# North Carolina State Univ., Raleigh.
COMPUTER EXPERIMENT STUDIES ON MECHANISMS FOR IRRADIATION INDUCED DEFECT PRODUCTION AND ANNEALING PROCESSES Progress Report, Period Ending 31 Aug. 1969
J. R. Beeler, Jr. Sep. 1969 41 p refs
(Contract AT(40-1)-3912)
(ORO-3912-1) Avail: CFSTI

Computer experiments were performed on point defect behavior in three model metals designed as alpha-iron, gamma-iron and nickel which were given properties similar to those of their real counterparts. Computation of vacancy migration energy matrix values was completed for vacancy migration near (110),(001), (112), and (111) free surfaces in alpha-iron. Simulation studies on the transition from small vacancy cluster configurations to faceted void configurations in pure alpha-iron were initiated. Configuration energies were computed for vacancy defect-carbon atom complexes and interstitial-carbon atom complexes in alpha-iron, gamma-iron, and nickel. These calculations indicated that the most stable complex formed by vacancies and carbon is the divacancy-carbon atom complex in both alpha-iron and nickel. Author (NSA)

N70-19579# Scientific Translation Service, Ann Arbor, Mich.
STUDY OF INTERNAL FRICTION OF ALLOYED MOLYBDENUM [ISSLEDOVANIE VNUTREINEGO TRENIYA LEGIROVANNOGO MOLIBDENA]
Yu. E. Busalov et al Oct. 1969 6 p refs Transl. into ENGLISH from Fiz. Khim. Obrab. Mater. (USSR), no. 1, 1968 p 117-118
Sponsored by AEC Prepared for Argonne Natl. Lab., Ill.
(ANL-Trans-782) Avail: CFSTI

An investigation was conducted to determine the degree of dislocation freezing during microalloying of Mo with elements of group 7A. Resulting data are the basis for a conclusion that a reduction of the energy of dislocation reaction with solute impurities occurs in microalloyed Mo. NSA

N70-19602# Naval Research Lab., Washington, D.C.
THE INFLUENCE OF YIELD STRENGTH AND FRACTURE TOUGHNESS ON FATIGUE DESIGN PROCEDURES FOR STRUCTURAL STEELS. EFFECT OF THERMAL UMKLAPP ON THE LOW TEMPERATURE ELECTRICAL RESISTIVITY
T. W. Crooker, E. A. Lange, and A. C. Ehrlich
(NAVSO-P-3012) Avail: CFSTI

The modes of failure and methods of analysis for fatigue design for structural steels ranging in yield strength from 30 to 300 ksi are outlined. It is shown that fatigue crack propagation characteristics of steels seldom vary widely in response to broad changes in yield strength and fracture toughness. Strength and toughness do vary widely among structural steels, however, and exert profound effects on the process of a failure by fatigue. A study of the thermal umklapp effect on the low temperature electrical resistivity is also reported. A theory of the resistivity of monovalent metals whose Fermi surface touches or nearly touches the Brillouin zone boundary is extended to include the presence of impurity scattering. Calculated deviations from Matthiessen's rule prove to be large and have a temperature dependence that could be spuriously interpreted as showing evidence of electron-electron scattering. Finally, significant technical progress on individual projects and problems are summarized briefly. Author

N70-19638# Battelle-Northwest, Richland, Wash.
IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, Aug.-Oct. 1968
T. T. Claudson, ed. Dec. 1968 234 p refs
(Contract AT(45-1)-1830)
(BNWL-932) Avail: CFSTI

Continuing research is reported for the participating organizations. Discussions are presented on irradiation effects on mechanical properties of metals, alloys, ceramics, cladding materials, embrittlement, and structural materials; microscopic and microstructure studies; sensitivity; and testing techniques and supporting studies. N.E.N.

N70-19658# Kresge-Hooker Science Library Services, Detroit, Mich.
HYDRIDE ORIENTATION IN ZIRCALOY TUBES AS A FUNCTION OF DEFORMATION, TEXTURE, AND STRESSES
E. Schelzke [1969] 26 p refs Transl. into ENGLISH from J. Nucl. Mater., (Germany), v. 30, 1969 p 324-336 Prepared for Bettis Atomic Power Lab.
(WAPD-Trans-123) Avail: CFSTI

A relationship was established between texture, stresses, and hydride orientation in Zircaloy tubes. It was established that the lamellar precipitates of zirconium hydride arranged themselves within a limited angular range which depends on the texture. This angular range can be regarded as an orientation range for the habit planes of the zirconium hydride precipitates and encompasses positions in the unit triangle of alpha zirconium within a range of 5 to 20 deg from the (0001) pole of n zirconium. The orientation of precipitates by means of stresses is only possible within this angular range. Author (NSA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N70-18331# National Aerospace Lab., Tokyo (Japan).
MEASUREMENTS OF TRANSIENT ABLATION OF TEFLON
Shigeaki Nomura 1969 14 p refs In JAPANESE; ENGLISH summary
(NAL-TR-179) Avail: CFSTI

Measurements of transient ablation of teflon were conducted in the stagnation region in a high enthalpy flow at Mach number 5, with stagnation enthalpy of 2,390 cal/g and impact pressure of 5mmHg. Concerning the transient ablation speed and temperature distribution changes, quantitatively good agreement was obtained between both the results of experiment and a finite difference analysis of heat conduction in teflon which takes into account the melting layer having considerably smaller thermal conductivity than that of solid teflon. The thermal conductivity of melted teflon was determined to be .0002 approximately 1003 cal/cm C derived from the experimental results of constantly ablating teflon. The results of finite difference analysis also show that the surface temperature rises sharply to an almost constant value in a few seconds, but that the thickness of the melted layer increases slowly. Considering this, it was noticed that it required several tens of seconds to arrive at a constant ablation rate under the experimental conditions. Examining the overall results of experiments and analysis, it is concluded that the quasi-steady treatment of aerodynamic heating to a transiently-ablating surface is valid. Author

N70-18334# Boeing Scientific Research Labs., Seattle, Wash.
ELECTRICAL IMPEDANCE OF ALUMINUM SURFACE OXIDE
Alan W. Smith and Ann Pollock Sep. 1969 31 p refs
(AD-697117; D1-82-0926) Avail: CFSTI CSCL 11/3

The impedance of surface oxides, present after etching or other treatment of aluminum, is shown to be characteristic of that of amorphous dielectrics with a frequency independent dielectric loss. Results with both electrolytic solution contacts and evaporated metal contacts indicate a thin barrier layer covered by a thicker permeable layer as occurs on a porous, anodized surface. Methods for determining the dielectric constant and the roughness are developed. The dielectric loss is related to hydration of the surface. Author (TAB)

N70-18335# Human Engineering Labs., Aberdeen Proving Ground, Md.
PHOTOMETRIC EVALUATION OF REFLECTION-REDUCING COATING FOR AIRCRAFT INSTRUMENT COVER GLASS
Harry R. Stowell and Robert W. Bauer Aug. 1969 34 p refs
(AD-696441; HEL-TM-12-69) Avail: CFSTI CSCL 11/3

Comparisons were made between plain instrument cover glass used on aircraft instrument panels and cover glass deposited with multilayer antireflection coating conforming to MIL-C-14806 and AMS 2521. Photometric measurements of reflections, light transmission and contrast indicated the effectiveness of the reflection-reducing coating. Reflected glare from the face of instruments was significantly reduced by the reflection-reducing coating and increased light transmission enhanced contrast on instrument dial faces. Author (TAB)

N70-18384# Air Force Systems Command, Wright-Patterson AFB, Foreign Technology Div.
SCIENTIFIC-RESEARCH WORK IN THE FIELD OF ADDITIVE CHEMISTRY
A. M. Kuliev 9 May 1969 10 p Transl. into ENGLISH from Azerb. Khim. Zh. (Baku), no. 3, 1967 p 23-27
(AD-696473; FTD-HT-23-897-68) Avail: CFSTI CSCL 11/8

In 1945 the Laboratory for the Synthesis of Oil Additives AzNII was formed, and in 1965, the Institute of Additive Chemistry was organized in Baku to serve as a center for experimental and theoretical studies for heavy industry. Their work on antioxidant, anticorrosion, antiwear and multifunctional oil additives is reviewed. Antioxidants based on nitrogen-containing compounds were prepared by condensation of alkylphenols with formaldehyde and carbamide, thiocarbamide, aliphatic and aromatic amines, or urethanes. Phosphorus- and sulfur-containing compounds prepared by condensation of alkylphenols or their sulfides with formaldehyde and amines or aniline and reaction with phosphorus trichloride are effective additives. AzNII-10 is based on p-tert. amylphenol. INKhP-21 and INKhP-25, condensation products of alkylphenols, formaldehyde, and an amine treated with phosphorus pentachloride and barium oxide hydrate, have antioxidant and anticorrosive properties. BFK is the reaction product of alkylphenol, formaldehyde and hydrated barium oxide. Sulfur-, chlorine-, and phosphorus-containing compounds impart antiwear properties. Author (TAB)

N70-18389# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE DEPENDENCE OF THE STRENGTH OF GLASS-REINFORCED PLASTICS ON THE DIAMETERS OF REINFORCING FIBERS
N. A. Osnach et al 2 Apr. 1969 12 p refs Transl. into ENGLISH from Vses. Nauchn-Issled. Inst. Novykh Stroit. Materialov. (USSR), no. 7, 1966 p 101-104
(AD-696521; FTD-MT-24-42-69) Avail: CFSTI CSCL 11/9

Laminated sheets were prepared by reinforcing unsaturated polyester resin PN-1 with 65 to 76 percent unwoven glass fibers embedded in a unidirectional arrangement. The modulus of elasticity of the fibers used was 30 to 5 percent higher than that of usual glass fibers. Ultimate tensile strength of the laminates slowly increases with increasing fiber diameter. The effectiveness of reinforcement expressed as the ratio of laminate strength to the strength of involved glass fibers increases steadily with increasing fiber diameter. Author (TAB)

N70-18395# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONFABRIC GLASS PLASTICS
G. D. Andreyevskaya 14 Mar. 1969 48 p Transl. into ENGLISH from Netkanyye Stekloplastiki (Moscow), 1967 p 1-48
(AD-696549; FTD-HT-23-958-68) Avail: CFSTI CSCL 11/9

This booklet is intended for readers interested in polymer materials, and especially glass-reinforced plastics, which are among the most promising polymer materials. Glass-reinforced plastics combine high strength with low weight and can therefore be successfully used as structural materials, particularly in aircraft manufacturing. It is also expected that glass-reinforced plastics will find

soon a wide application in construction of small, light buildings, automobile and railroad cars, sport equipment, etc. The booklet outlines the properties of polymers, polymer adhenon to glass, glass reinforced plastics structure, their heat resistance, etc.
Author (TAB)

N70-18405# National Bureau of Standards, Washington, D.C.
ELECTRICAL GENERATION OF MOTION IN ELASTOMERS
S. Edelman, S. C. Roth, and L. R. Grisham *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 1–9 refs (See N70-18404 07-32)
Avail: CFSTI

Motion occurring in response to an applied electrical signal was studied in a number of elastomers. Motion at double the exciting frequency (electrostricition) was common. Linear response was found in a few materials. A few showed linear response in their original condition. Treatment with heat and intense electric fields caused linear response to appear or to increase in others. Superposition of a d.c. bias on the driving signal linearized the double frequency response and increased the linear response.
Author

N70-18441# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MODIFICATION OF FIBROUS DISPERSED STRUCTURES OF LITHIUM STEARATE IN HYDROCARBON OILS
G. G. Shchegolev et al 30 Apr. 1969 36 p refs Transl. into ENGLISH from Proc. of Konf. po. Fiz-Khim. Mekhan. Poristykh i Volonknistykh, Dispersnykh Struktur i Mater., (Riga), 1965 p 569-603
(AD-696304; FTD-HT-23-1176-68) Avail: CFSTI CSCL 11/8

The effect of cooling and of various additives on the structure, shear strength, and oil loss of lithium lubricating greases was studied on lithium stearate and remelted commercial lithium grease. The sedimentation rate, particle size of the greases, and the effect of mechanical grinding on the lubricating properties of the greases were studied; the microstructure of the greases was determined by electromicroscopy.
TAB

N70-18468# Army Foreign Science and Technology Center, Washington, D.C.
COLORLESS OPTICAL GLASS
2 Oct. 1969 38 p Transl. into ENGLISH from a Russian Report
(AD-696184; FSTC-HT-23-637-68) Avail: CFSTI CSCL 11/2

This standard establishes specifications for different types of achromatic optical glass. It lists optical characteristics of different brands of glass and sets forth the standards to determine adherence of glass blanks to established specifications. The standard establishes categories according to refractive index, mean scattering index, optical uniformity, double refraction, light absorption, flawlessness, and bubble index. The appendix of the standard lists the different types of optical instruments for which the glass may be used.
Author (TAB)

N70-18519# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FRICTIONAL PROPERTIES OF CERTAIN POLYMERIC MATERIALS
S. M. Genkin et al 21 May 1969 16 p refs Transl. into ENGLISH from Tr. Vses. Nauch.-Issled. Inst. Zhelaznodorozh. Transp. (Moscow), no. 352, 1968 p 70-77
(AD-696506; FTD-MT-24-54-69) Avail: CFSTI CSCL 11/4

The friction properties of asbestos-rubbers made from various synthetic rubbers and asbestos, baryta, iron minimum, etc., were investigated by examining the thermal stability of the material when subjected to friction. The measurements showed that asbestos-rubbers possess good braking efficiency and durability and can be used in a braking block. Moisture decreases the braking efficiency of this material.
Author (TAB)

N70-18521 Princeton Univ., N.J. Frick Chemical Lab.
STUDIES ON THE STRESS RELAXATION OF POLYSTYRENES IN THE RUBBERY-FLOW REGION
A. V. Tobolsky, M. Narkis (Washington Univ., St. Louis), and I. L. Hopkins (Bell Telephone Labs., Inc., Murray Hill, N.J.) Oct. 1969 27 p refs
(Contract N00014-67-A0151-0011)
(AD-697310; ONR-TR-RLT-118) Avail: CFSTI CSCL 11/9

Relaxation modulus curves for monodisperse and polydisperse polystyrenes are compared and the significant effect of molecular weight distribution on these curves is shown. An empirical three-parameter equation is shown to describe well the stress relaxation behavior of monodisperse polystyrenes. New data for high molecular weight monodisperse polystyrenes are presented and used to extend the applicability of previous quantitative relations for higher molecular weights. The stress relaxation technique is shown to be sensitive to the type of plasticizer used at low concentrations.
Author (TAB)

N70-18555# Coating and Chemical Lab., Aberdeen Proving Ground, Md.
DEVELOPMENT OF A MULTI-METAL PRIMER Final Report
Stanley F. Koutek Oct. 1969 46 p
(AD-696446; CCL-272) Avail: CFSTI CSCL 11/3

Some currently employed specification epoxy primers and experimental formulations were exposed at the Panama test sites for corrosion resistance studies. Inhibiting pigments considered included strontium, zinc and basic zinc chromates up to 90% by weight of the total pigmentation at different pigment volume concentrations. Polyamide and amino-silane curing agents were used. Experimental vinyl and polyurethane primers offered no significant improvement in corrosion resistance when compared to two existing specification primers, particularly on pretreated substrates.
Author (TAB)

N70-18560# Pennsylvania Univ., Philadelphia.
LABORATORY FOR RESEARCH ON THE STRUCTURE OF MATTER Annual Technical Report, 1 Jul. 1968-30 Jun. 1969
Eugene R. Nixon 30 Jun. 1969 265 p refs
(Contract ARPA SD-69)
(AD-697182; AR-9) Avail: CFSTI CSCL 11/7

Contents: Basic chemistry and synthesis; Structure of materials; Kinetics and mechanisms; Thermodynamics and mass transport; Mechanical properties; Defects and phase transformation; Surface and thin films; Electronic and magnetic properties; Interaction with radiation; and Quantum mechanics and statics.
TAB

N70-18567# Ministry of Technology, London (England). Materials Div.
DIELECTRIC PROPERTIES OF GLASS
J. O. Isard Mar. 1969 19 p refs
(AD-697358; D-MAT-158) Avail: CFSTI CSCL 11/2

Research on the electrical properties of glass was carried out over a period of eleven years with a view to the investigation and development of glass as a dielectric material, particularly in high temperature service. The work was directed towards an elucidation of the mechanisms of conduction and dielectric loss, and of the factors affecting the dielectric constant and its temperature coefficient.
Author (TAB)

N70-18581# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHARACTERISTICS OF DIAMOND-GALVANIC COATINGS
V. N. Bakul et al 8 Sep. 1969 10 p ref Transl. into ENGLISH from Mashinostroitel (Moscow), no. 10, 1968 p 21-22
(AD-696172; FTD-MT-24-157-69) Avail: CFSTI CSCL 11/3

Investigations were conducted for the purpose of determination of the most suitable granularity of diamond powder for coating of sliding friction joints with low coefficient of friction and high wear resistance.
TAB

N70-18705*# TRW Systems Group, Redondo Beach, Calif.
METAL FABRIC AND SILICONE MATERIALS. THERMAL PROPERTY MEASUREMENTS REPORT
8 Jan. 1970 19 p refs
(Contract NAS9-3670)
(NASA-CR-102169; TRW-70-8526.161-03) Avail: CFSTI CSCL 11G

The solar absorptance and near-normal emittance of three samples of material have been determined: The material was identified as (1) Blue Silicone Rubber; (2) Chromel-R coated with Silicone compound; and (3) Karma Fabric. Solar absorptance was determined by measuring the spectral directional reflectance from 0.28 to 2.5 microns in the spectrophotometer with integrating sphere design. This reflectance was integrated over the solar irradiance to obtain solar absorptance. The near-normal 300 K emittance was determined by measuring the spectral directional reflectance in the paraboloid reflectometer from 2.0 to 26 microns. This reflectance was integrated over the 300 K Planckian radiator function to obtain the near-normal directional emittance. This near-normal emittance was multiplied by the theoretically determined hemispherical-to-normal emittance ratio. All reflectance measurements were made with a highly reflective aluminized surface behind the sample. Author

N70-18706*# Whittaker Corp., San Diego, Calif. Research and Development Div.
DEVELOPMENT OF NONFLAMMABLE ADHESIVES Final Technical Report, 17 Sep. 1968-20 Jan. 1970
Alfred H. Mc Leod and Walter P. Fitzgerald, Jr. 20 Jan. 1970 42 p refs
(Contract NAS9-8428)
(NASA-CR-102176) Avail: CFSTI CSCL 11A

Fluorinated polyurethanes based on the polyether of perfluoropropylene oxide and 1-chloro-3,5,6-trifluoro-m-phenylene diisocyanate were examined as nonflammable adhesives. Additives were investigated as a potential route to improved nonflammable properties. Certain modifications of these fluorinated polyurethanes resulted in a broad temperature range adhesive system with improved elevated temperature performance and acceptable nonflammable properties. Block polymers were prepared from the fluorinated polyurethanes which, when tackified, resulted in an unusual pressure sensitive adhesive. Scale-up studies were conducted on the materials used on this program. Author

N70-18721*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DESCRIPTION AND APPLICATIONS OF FLUOREL L-3203-6
D. E. Supkis [1969] 40 p refs
(NASA-TM-X-62657, MSC-01275) Avail: CFSTI CSCL 11J

The manned space flight program has witnessed countless new equipment and materials developments to meet the needs of a relatively new technology. One of the primary needs, as made evident by the Spacecraft 204 fire at Cape Kennedy, was for new nonflammable materials to be used in the 100% oxygen atmosphere of spacecraft. Fluorel L-3203-6 has demonstrated considerable versatility of application and has exhibited the best nonflammability characteristics of any of the ambient-cured Fluorel compounds developed to date. The mill sheet can be fabricated into such items as belts, flight boot soles, circuit breakers, and toggle switches. By solvation (20 percent of Fluorel L-3203-6 solids homogenized in methylethylketone (MEK)), this compound can be used as a paste or spray solution for conformal coatings on flammable materials which cannot be replaced. Thus, Fluorel L-3203-6 provides two means of fireproofing by serving as a material for fabrication of nonflammable components and as a coating for flammable substrates. In addition, the L-3203-6 solution has been used as an adhesive. The physical properties of the cured compound are presented. Author

N70-18773# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NITRATED OILS
S. E. Krein et al 3 Jul. 1969 89 p refs Transl. into ENGLISH from Nitrovannyye Masla (Moscow), 1967 p 1-158
(AD-696317; FTD-MT-24-441-68) Avail: CFSTI CSCL 11/8

The problems of the synthesis and manufacture of corrosion inhibitors obtainable by nitration of mineral oils and petrolatum are reviewed. The chemistry and technology of nitration, pilot and industrial installations and various nitrating agents are described. The mechanism of corrosion inhibiting effect on metals is discussed. A considerable part of the monograph is devoted to a description of testing methods and to practical experience in the use of nitrated oils. Some new compositions are recommended. The use of nitrated oils as fuel additives is mentioned, as corrosive inhibiting facilitating the combustion and antistatic agents. Author (TAB)

N70-18832*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
NONFLAMMABLE FLUOREL COMPOUNDS
D. E. Supkis 22 Apr. 1968 58 p *Its* NASA Apollo Working Paper No. 1337
(NASA-TM-X-62658) Avail: CFSTI CSCL 11J

This program was designed to initiate research on new elastomers and to investigate and develop Fluorel for use as a nonflammable spacecraft material. The Fluorel copolymer, with the addition of fire-retardant ingredients, can be made nonflammable under the most rigid spacecraft conditions of 16.5 psia, bottom ignition, in a 100% oxygen atmosphere. On proper balance of formulary ingredients and technique, the Fluorel mill stock can be foamed, molded, or extruded. By solvation, the material can be controlled as paste, coating, or spray solution. Such a variety of properties and forms presents exciting possibilities for replacing flammable spacecraft components. This paper discusses the properties of the more promising Fluorels under consideration. These Fluorels are being investigated for a variety of applications and the current effort in each of these categories is presented. Since this is a continuing project, the materials and application information contained are of an interim nature and are intended for periodic revision. Author

N70-18835# IIT Research Inst., Chicago, Ill.
CHARACTERIZATION OF CERAMIC PARTICLES. ANALYSIS OF ALUMINA BY DIELECTRIC MEASUREMENTS Final Report, 15 Mar. 1968-14 Oct. 1969
A. J. Mountvala, G. Y. Onoda, E. J. Onesto, and A. G. Pincus 1 Nov. 1969 64 p refs
(Contract N00014-68-C-0305)
(AD-697269; IITRI-G-8022-FR) Avail: CFSTI CSCL 11/2

The purpose of the study was to determine if dielectric behavior can be a useful tool for characterizing ceramic particulates. A qualitative examination was made on four commercial aluminas ranging in particle size from 0.3 micro to 45 micro. The surface chemistry and environment of these powders were varied. Pronounced dielectric effects were found at frequencies below 100,000 Hz and were attributed to surface conductance. The conductance results from the diffusion of ionized species along the surface, and is aided by adsorbed water which allows electrolytes to form and which serves as a vehicle for diffusion. The surface conduction causes individual particles to become polarized when a field is applied. Also, some conduction occurs from particle to particle, causing an electrode polarization effect. The contribution to dielectric effects due to the local and continuous conduction mechanisms have been separated experimentally. These results indicate that dielectric measurements appear useful for monitoring the level of ionic impurities and adsorbed water on particulates and as a tool for ceramic processing studies. Author (TAB)

N70-18850*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE DEVELOPMENT OF HXW THERMAL COATING

Roger J. Harwell 16 Jan. 1969 12 p
(NASA-TM-X-53985) Avail: CFSTI CSCL 11C

The development of a coating for use on space vehicles to control their temperature while in a space environment is described. This is accomplished by varying the optical properties of the coating to control thermal absorption and emission rates of the vehicle surface. The inorganic coating described has the capability of providing the necessary optical properties for thermal control and is also very stable in the environment of vacuum and solar radiation. The HXW coating is primarily a water suspension of synthetic mica that is gelled with a silicate solution. The products used in the coating are available from commercial sources and are relatively inexpensive for this type of coating. Author

N70-18895*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
MICROYIELD PROPERTIES OF TELESCOPE MATERIALS Final Report
W. William Woods 21 Jan. 1970 85 p refs
(Contract NAS1-8851)
(NASA-CR-66886) Avail: CFSTI CSCL 11G

Torsional and axial measurements of yield strain in beryllium-0.2%-Fe alloy are compared and found to have good agreement in accordance with the octagonal stress theory. Silicic materials, including CER-VIT, fused silica, and ULE fused silica, were also tested and found to have no apparent yield up to 70 MN/sq M stress when etched. With untreated ground surfaces, apparent yield approaching one microstrain is observed in torsion with the silicic materials. Time dependent strain characteristics for the four materials are presented and discussed. Author

N70-19058# Air Force Systems Command, Wright-Patterson AFB, Ohio.
INVESTIGATION OF LIGHTNING STRIKE DAMAGE TO EPOXY LAMINATES REINFORCED WITH BORON AND HIGH MODULUS GRAPHITE FIBERS
L. G. Kelly and H. S. Schwartz *In its* Lightning and Static Elec. Conf., Pt. 2, May 1969 p 485–519 refs (See N70-19027 07-02)
Avail: CFSTI

Flight tests of the three F-111 components (airflow director panel, wing trailing edge panel, and aft main landing gear door) were performed for 18 months, while tests of the other components (landing flap, wing tip, main landing gear strut door, torque tube access door, fire access door, antenna cover, rudder, stabilizer leading edge cover, and wing fence) were initiated more recently. High modulus graphite fiber reinforced plastics were developed for prototype aerospace structural components. These plastics are not as far along as boron fiber reinforced plastics from the component number, size, and complexity standpoints. A simulated fuselage configuration of stiffened shell design measuring 4 × 2 ft. was fabricated. Some results concluded that: an acrylic base aluminum paint was not effective in providing lightning protection to boron or graphite fiber reinforced plastics, and a 6 mil plasma sprayed aluminum coating on boron plastic laminate panel provided good protection from lightning strike damage at current levels up to 200 kiloamps. J.A.M.

N70-19059# Lightning and Transients Research Inst., Minneapolis, Minn.
MECHANISMS OF LIGHTNING DAMAGE TO COMPOSITE MATERIALS
J. D. Robb *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 520–529 (See N70-19027 07-02)
Avail: CFSTI

Lightning contact and damage mechanisms are reviewed for composite structures indicating that they may be struck by any of the major lightning discharge components, including initial high current impulses, intermediate currents characteristic of cloud-to-cloud discharges, and low current continuing components. Problems such as structural damage, pulse coupling into electrical circuits, hazards to fuel systems, and precipitation-static radio interference are discussed. Author

N70-19060# Philco-Ford Corp., Philadelphia, Pa.
THE SUSCEPTIBILITY OF ADVANCED FILAMENT ORGANIC MATRIX COMPOSITES TO DAMAGE BY SIMULATED LIGHTNING STRIKES
W. M. Fassell, A. P. Penton, and J. A. Plumer (General Elect. Co., Philadelphia) *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 530–570 (See N70-19027 07-02)
Avail: CFSTI

A research and development program simulating lightning strikes on high modulus graphite, organic matrix composites is reviewed. Boron filament, epoxy matrix composites were included to provide comparative data. Three series of electrical impulse screening tests were performed on typical boron and graphite epoxy composites intended for aircraft use. Unidirectional boron filament epoxy composites lost up to 89 percent of their flexure strength at impulse current levels as low as 2,000 to 3,000 amps. Photomicrographs of damaged boron fibers at the failure planes are shown, and fragmentation of the boron fiber occurred in the axial and transverse modes. The mode of failure was successfully modeled, based on the concept of differential heating of the tungsten boride core and the boron coating. A concept involving a method for making electrical contact to all fiber ends, and thereby distributing the current more uniformly and avoiding the damage threshold of the individual fibers is described. Tests were also performed on boron composites to determine higher current level effects. Natural lightning and laboratory simulation techniques are noted. J.A.M.

N70-19162 National Lending Library for Science and Technology, Boston Spa (England).
HEAT EFFECTS OF VITREOUS STRUCTURES
S. Solacolu et al Sep. 1969 22 p refs Transl. into ENGLISH from Rev. Chim. (Bucharest), v. 18, no. 4, 1967 p 208-212
(NLL-RTS-5294) Avail: Natl. Lending Library, Boston Spa, Engl.: 12s 6d or 2 NLL photocopy coupons

An apparatus of original design was used for differential thermal analysis of the blast-furnace slags of the system MgO-CaO-A1203-Si02. The thermograms of compositions corresponding to some chemical compounds of the above-mentioned system show endothermic and exothermic effects. The modifications undergone by vitreous structures according to the melting point and granulation temperature are reflected in thermograms by a modification of the extent and position of the exothermic effects. The endothermic effects of low temperatures are attributed to decomposition of hydrated compounds, while those of high temperatures are attributed to structural changes taking place on a decrease in the viscosity and preceding crystallization. The exothermic effects are due to crystallization of the vitreous structures in glass, and their extent and position are modified according to their nature and degree of organization. The possibility is noted of a correlation of the exothermic effects with the types of structural elements present in the fused mass and in glass. Author

N70-19188# Gulf General Atomic, San Diego, Calif.
RESEARCH ON GRAPHITE Quarterly Progress Report, Period Ending 14 Aug. 1969
G. B. Engle, J. C. Bokros, and R. J. Price 27 Aug. 1969 25 p refs
(Contract AT(04-3)-167)
(GA-9675) Avail: CFSTI

Studies to determine the degree of graphitization in a number of moderator graphites were completed. Anisotropic graphites consist of up to 10 vol-% semigraphitic regions coexisting with highly graphitic regions, whereas near-isotopic graphites are predominantly semigraphitic with smaller amounts of crystalline

material that is highly aligned. Calcined petroleum cokes are under study to determine the effect of calcined density on crystalline growth. Metallic additives are being studied as an aid to low-temperature graphitization of compacts fabricated with aluminum-doped petroleum coke. A series of compacts was fabricated and baked at 900 C to evaluate the effect of aluminum content on the ratio of graphite conversion at 2100 to 2300 C. Microhardness measurements were completed on titanium-doped and titanium-free pyrocarbons annealed for 1 hr at 100 C temperature increments between their deposition temperature and 3000 C. Author (NSA)

N70-19228# Radio Corp. of America, Harrison, N.J. Special Electronic Components Div.
SILICON GERMANIUM THERMOELECTRIC MATERIALS AND MODULE DEVELOPMENT PROGRAM Quarterly Report, 1 Apr.-30 Jun. 1969
30 Jun. 1969 83 p
(Contract AT(29-2)-2510)
(ALO-2510-6; QR-6) Avail: CFSTI

Development of the capability to coat graphite hot shoes with Si and the establishment of an initial capability to bond these shoes to SiGe are reported. It was demonstrated on one couple that the nominal 80 at.% SiGe gives an improved performance over the 63.5 at.% SiGe materials. Operation of the same couple with the hot shoe temperature increased to 1250 C for 48 hours without any damage to the couple or deterioration in performance is reported. The objective parameters for two foil-insulated converters to be fabricated during FY70 was established; both converters will be optimized for both specific power and efficiency. The converters are intended to simulate operational devices as closely as possible. The design parametric of the first converter (C-4) was performed. The device efficiency of the 5-watt foil insulated converter was improved to 6.6% at 1000 C hot shoe temperature by placement of additional microquartz insulation in the small gap between the foil and the couples. Author (NSA)

N70-19257# Atomic Energy of Canada, Ltd., Pinawa (Manitoba).
STRENGTH DISTRIBUTION AND FRACTURE BEHAVIOUR OF STRUCTURAL CERAMICS OF LOW NEUTRON ABSORPTION CROSS SECTION
R. Stevens and T. D. Clausen Oct. 1969 25 p refs
(AECL-3422) Avail: CFSTI

As part of an investigation into the use of structural ceramics under tension in a nuclear environment, Lucalox, Poco graphite, and KT-SiC were fractured in four point bending tests. The zirconium alloy, Ozhennite, was used as a comparison metal. Weibull statistics were applied to the fracture stresses measured, and a method for estimating the zero stress is described. Poco graphite was the ceramic with the most reproducible properties, but the variability in all three ceramics, as shown by their Weibull exponents, was considerably more than that for Ozhennite. Nevertheless the ceramics had sufficient short time strength at low probabilities of failure (e.g. approximately 5000 lbf/in sq at a failure probability of 10 to the minus 6 power per cent) for their application under tension to merit consideration. Work of fracture values for the ceramics were approximately 5 × 10 to the minus 4 power erg/cm and are discussed in relation to their metallographic structure. Author

N70-19306 Carnegie-Mellon Univ., Pittsburgh, Pa.
EFFECT OF RADIATION ON THE ADHESIVE PROPERTIES OF EPOXY-METAL AND EPOXY-GLASS ADHINTS
Anthony Lynn Tilmans (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 68-17617

The method used in this thesis to determine whether there is a cohesive or adhesive failure involves bulk tests at different radiation levels. These values are used as a basis for comparison with adhesive systems. By testing two component shear specimens at similar radiation levels, a comparison can be made to determine if the failure is in the adhesive or at the interface. Preliminary tests were performed on the epoxy system to determine the criteria to be used throughout the study and to avoid any difficulty that might arise at a later time. These tests included cure cycle, exothermic reaction temperature, dose rate of radiation, environment during radiation, tension test procedure, and absorbed radiation in the sample. A photographic strain technique was used as a new tension test procedure developed to work with minisamples for radiation testing. Author

N70-19337# Gulf General Atomic, San Diego, Calif.
IRRADIATION-INDUCED DIMENSIONAL CHANGE IN BORONATED GRAPHITE: RESULTS OF THE BG-1 (GA-19-1) EXPERIMENT
O. M. Stansfield and N. L. Sandefur 29 Jul. 1969 48 p
(Contract AT(04-3)-167)
(GAMD-9276) Avail: CFSTI

Boronated graphites containing 21 to 35 wt % boron and fabricated by extrusion or warm pressing techniques were irradiated at 650 + or − 100 C to fast neutron exposures of 2 × 10 to the 21st power to 4 × 10 to the 21st power n/sq cm, which was similar to 2 to 4 year exposure in a High Temperature Gas-Cooled Reactor (HTGR). Dimensional changes of the extruded and warm pressed specimens are given. Comparison of nonboronated and boronated warm pressed graphites showed that the addition of B4C granules to the graphite matrix produced enhanced expansion at a given exposure even when the B-10 content of the B4C was reduced to produce a relatively inert B4C particle. Several mechanisms that might act to accelerate expansion in boronated graphite were discussed. Direct use of boronated graphite irradiation data, would therefore provide the most reliable prediction of absorber dimensional change during HTGR service. NSA

N70-19369# Gulf General Atomic, San Diego, Calif.
INTERPRETATION OF DIMENSIONAL CHANGES CAUSED IN PYROLYTIC CARBON BY HIGH-FLUENCE NEUTRON IRRADIATION
J. C. Bokros and K. Koyama 1 Jun. 1969 35 p refs
(Contract AT(04-3)-167)
(GA-9600) Avail: CFSTI

Irradiation-induced dimensional changes in a variety of pyrolytic carbons at 900 to 1300 C showed that during irradiation, the rate at which the specimens changed dimensions accelerated. The accelerations were most pronounced in dense, isotropic carbon and were accompanied by the generation of pores in the structure, which caused a volume expansion. The data obtained at approximately 900 C suggested that the accelerations were due primarily to a degradation in crystal structure that enhanced the instability of the crystallites. At the higher irradiation temperatures, increases in anisotropy contributed significantly to the accelerations. The volume expansions, the degradation of the crystal structure, and changes in thermal conductivity were all less for irradiations above 1200 than at 1000 C. These observations, together with the increases in anisotropy, are believed to be manifestations of the fact that the intercrystallite irradiation creep rate is substantially higher at irradiation temperatures above 1200 than at 1000 C. High creep rates provide an effective mechanism which relaxes the stresses that are generated between adjacent, misaligned crystallites during irradiation. Author (NSA)

N70-19373# Gulf General Atomic, San Diego, Calif.
RESEARCH ON GRAPHITE Annual Report, 15 May 1968-14 May 1969
G. B. Engle, J. C. Bokros, and R. J. Price 17 Jun. 1969 165 p refs
(Contract AT(04-3)-167)
(GA-9433) Avail: CFSTI

Results of investigations of relations between the properties, microstructure, and irradiation behavior of carbonaceous and graphitic materials required for high-temperature reactors are

summarized. Efforts during the report period were devoted to research on properties and structures of carbon and graphites, and to studies of radiation effects on these structures and properties. NSA

N70-19379# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
IRRADIATION OF GRAPHITE AT TEMPERATURES OF 300 TO 1200 DEG C
J. W. Helm Aug. 1969 183 p
(Contract AT(45-1)-1830)
(BNWL-1056-B) Avail: CFSTI

Irradiations of a large variety of graphites have been conducted at temperatures from 300 to 1200 C to maximum neutron fluences of 2.7 × 10 to the 22nd power nvt (E > 0.18 MeV). As temperatures and neutron fluences increase, bulk expansion of the graphite becomes the controlling behavior in all orientations. Materials which are well graphitized, highly crystalline, isotropic, and have a high CTE show the lowest contraction at moderate fluences. The data and information presented comprise the appendices to BNWL-1056A and include details of sample selection, experimental procedures, experimental results, and supplemental figures. Author (NSA)

N70-19393# Gulf General Atomic, San Diego, Calif.
MECHANICAL PROPERTIES OF FIBROUS INSULATION MATERIALS CONSIDERED FOR THE THERMAL BARRIER FOR A PRESTRESSED CONCRETE REACTOR VESSEL
G. Jones 1 Aug. 1969 42 p refs
(Contract AT(04-3)-633)
(GAMD-9074) Avail: CFSTI

Considering the handling properties of the material and the necessity for a good seal between the insulation and the prestressed concrete reactor vessel liner wall, directly applied kaowool compressed to 12 lb/ft3 was found to be the best material for the Class A thermal barrier. Tests were performed on kaowool, microquartz, refrazil, and siltemp. The concept assumes that kaowool will retain its resilience during the 30-year life of the reactor. Conditions most likely to cause the kaowool to lose resilience were investigated, and include tests of creep at high temperature, water immersion, steam exposure, compression cycling and irradiation exposure. All tests proved successful. NSA

N70-19398# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
GRAPHITE THERMAL EXPANSION REFERENCE FOR HIGH TEMPERATURES
P. S. Gaal Jul. 1969 73 p refs Sponsored in part by AEC
(WANL-TME-1941) Avail: CFSTI

The design requirements of the aerospace and high temperature nuclear reactor industries necessitate reliable thermal expansion data for graphite and other carbonaceous materials. Currently there are no accepted standards or reference materials which can be used in carbon-rich atmospheres at temperatures ranging to 2500 C. The feasibility of an acceptable reference for calibration of expansion measuring systems that operate in such test environments (furnaces utilizing graphite heaters, for example) is discussed. The contention of the study is that present-day graphite technology provides acceptable materials for stable, reproducible references, as reflected by some of the candidate materials. The repeatability for a single specimen in a given expansion measuring system was found to be + or -1%, while the combined results of several tests made on a number of samples fell within a + or -2.5% bond. Data and results of testing on several grades of candidate graphites are given. Author (TAB)

N70-19414 + Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
EFFECT OF LOW AND INTERMEDIATE STRAIN RATES ON THE COMPRESSIVE STRENGTH OF CELLULAR CARBON AT THREE DENSITY LEVELS
R. E. Oakes, Jr. 2 Oct. 1969 12 p refs
(Contract W-7405-eng-26)
(Y-1689) Avail: CFSTI

Cellular carbon in the unbonded state at nominal density levels of 0.05, 0.10, and 0.22 g/cc has been tested in compression, both parallel and normal to the direction of cell rise, at strain rates between 1.7 × 10 to the minus 5th power and 50 in./in.-sec. Effects of the strain rate on the ultimate compressive strengths have been determined. Author (NSA)

N70-19600*# Monsanto Research Corp., Dayton, Ohio. Chemical Hazards Branch.
IDENTIFICATION OF VOLATILE CONTAMINANTS OF SPACE CABIN MATERIALS Final Report, Jan.-Jun. 1969
John V. Pustinger, Jr., F. Neil Hodgson, J. E. Strobel, and R. L. Evers. Wright-Patterson AFB, Ohio. AMRL Oct. 1969 75 p refs Sponsored jointly by NASA and AF
(Contract F33615-67-C-1357)
(NASA-CR-108213; AMRL-TR-69-71) Avail: CFSTI CSCL 11D

Nineteen candidate space cabin materials were tested to determine weight-loss characteristics and to identify their gas-off products. The materials were screened initially, using thermogravimetric techniques for measuring weight loss at moderate temperatures (ambient to 68 + or - 1 C) for 22.5 hours in 5 psia nitrogen, to select those candidate materials that lose from 0.001 to 1.0% of their weight, excluding water. The selected materials were then stored in 9-liter chambers at 68 + or - 2 C for 72 hours and at 25 + or - 2 C for 30 days. Atmosphere in the chambers was oxygen at a pressure of 5 psia. The gaseous contaminants evolved from the test materials were identified by combinations of gas chromatography and mass spectrometry. Author

N70-19612*# Washington Univ., Seattle. Ceramic Engineering Div.
INTERDISCIPLINARY RESEARCH CONCERNING THE NATURE AND PROPERTIES OF CERAMIC MATERIALS Semiannual Status Report, 16 Jun.-15 Dec. 1969
James I. Mueller 15 Dec. 1969 44 p refs
(Grant NGL-48-002-004)
(NASA-CR-108214; SASR-13) Avail: CFSTI CSCL 11B

The research status reports in ceramic materials are presented. The studies are grouped as: chemical, mechanical properties, and atomic and molecular. Also included for the report period are lists of: ceramic materials research seminars, theses published and prepared papers. F.O.S.

N70-19634# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
METALS AND CERAMICS DIVISION Annual Progress Report, Period Ending 30 Jun. 1969
Sigfred Peterson, comp. and ed. Oct. 1969 246 p refs
(Contract W-7405-eng-26)
(ORNL-4470) Avail: CFSTI

The following five programs are reviewed: (1) Fundamental programs, which include crystal physics, deformation and annealing of metals, deformation of crystalline solids, diffusion in solids, electron microscopy, ceramics research, Mossbauer studies of alloys, physical ceramics and properties, spectroscopy of ionic media, superconducting materials, surface reactions of metals, theoretical research, and X-ray diffraction; (2) High-temperature materials, including physical and mechanical metallurgy of refractory alloys, tungsten metallurgy, alkali-metal corrosion of high-temperature materials, nitride fuels, and materials development for isotopic power programs; (3) General fuels and materials research, including fuel element fabrication, joining research on nuclear materials, nondestructive testing, research reactor core improvement and procurement assistance, sol-gel fast reactor oxide fuels, and zirconium metallurgy; (4) Reactor development support, including desalination, gas-cooled reactor program, heavy section steel technology, high flux isotope reactor target development, LMFBR cladding and

structural materials, military reactor fuel element procurement assistance, molten-salt reactor program, reactor evaluation, thorium utilization, and water reactor safety; and (5) Other program activities, which include absorber materials for SO2 from flue gases, metallography, and the NERVA program metallurgical support. NSA

N70-19673# Massachusetts Univ., Amherst. Polymer Research Inst.
SCATTERING OF LIGHT BY FILMS HAVING NONRANDOM ORIENTATION FLUCTUATIONS, PART 2
T. Hashimoto and R. S. Stein Sep. 1969 25 p refs Sponsored in part by Am. Chem. Soc.
(Contract Nonr-3357(01))
(AD-696560; ONR-TR-121) Avail: CFSTI CSCL 20/2

The theory for scattering of light from films in which the orientation correlation between two scattering elements depends upon the angle beta between the optic axes and the vector connecting the two elements is extended. A delta-function type dependence is assumed in which the correlation is strongest when beta equals some preferred value of beta sub o. Calculated results of scattered intensities are shown to be similar to experimental observations. Author (TAB)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N70-18305# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
ON STATE ESTIMATION FOR DISTRIBUTED PARAMETER SYSTEMS
J. S. Meditch Sep. 1969 24 p refs
(AD-696279; DI-82-0917; Rept-37) Avail: CFSTI CSCL 9/4

Sequential algorithms for prediction, filtering, and smoothing are developed for a class of linear distributed parameter systems. The class of systems concerned is that involving noisy measurement data which are obtained from averaging and scanner type sensors. The basic tools of the development are the least-squares estimation viewpoint, the calculus of variations, and the sweep method for two-point boundary-value problems. An example involving the heat equation is presented to illustrate the results. Author (TAB)

N70-18324* Research Analysis Corp., McLean, Va.
ON THE THEORY AND APPLICATIONS OF INTERVAL LINEAR PROGRAMMING
Philip D. Robers and Adi Ben-Israel (Northwestern Univ.) Oct. 1969 45 p refs Sponsored in part by NSF and NASA
(Contract DAHC19-69-C-0017; Grant NSF GP-7550)
(AD-695659; NASA-CR-107938; RAC-TP-379) Avail: CFSTI CSCL 12B

The term "interval linear programming" refers to the theory, computational methods, and applications of problems having the form denoted by IP maxim for solving the general IP are summarized in this paper. A FORTRAN listing for SUBOPT is given in App. A. Some applications for which interval linear programming may save computational effort are also discussed. Author (TAB)

N70-18332# National Aerospace Lab., Tokyo (Japan).
NECESSARY CONDITIONS FOR THE OPTIMAL WEIGHTING MATRICES OF QUADRATIC PERFORMANCE INDEX TO MAXIMIZE THE MEASURE OF THE CONTROLLABLE SET
Nagakatsu Kawahata 1969 18 p refs In JAPANESE; ENGLISH summary
(NAL-TR-178) Avail: CFSTI

A set of necessary conditions is presented to determine the optimal weighting matrices of the quadratic performance index in cases where the final time of the process is specified finitely. The feedback control system may be said to be used essentially for achieving the predetermined purpose as well as possible, even if there exist large deviations or errors in the actual state to the desired state space trajectory during the process. Such an essential use of the feedback control system is the main concept used to derive a set of necessary conditions for the optimal weighting matrices in this paper. The controllable set is defined to consists of all of the states which fall within the given allowable error ellipsoid at the end of the process by the linear feedback control law with finite gains, although such a definition of the controllable set is somewhat different from the usual one on optimal control theory. It is first shown that the measure of such a controllable set during the process depends on the weighting matrices. From the essential purpose of the feedback control mentioned above, it is clear that the larger the measure of the controllable set is at any time of the process, the better the system is. The necessary conditions for these matrices are derived in the same way as in the usual optimal control theory. Author

N70-18338# Colorado State Univ., Fort Collins.
FRACTIONAL FACTORIAL DESIGNS FOR ESTIMATING MAIN EFFECTS ORTHOGONAL TO TWO-FACTOR INTERACTIONS: 3 SUPERSCRIPT N AND 2 SUPERSCRIPT M TIMES 3 SUPERSCRIPT N SERIES
J. N. Srivastava and D. A. Anderson Aug. 1969 25 p refs
(Contract F33615-67-C-1436)
(AD-697021; ARL-69-0123) Avail: CFSTI CSCL 12/1

Fractional factorial designs are considered of the (3 superscript n) and (2 superscript m) x (3 superscript n) series, and of resolution IV, i.e. where one desires to estimate only the main effects but the 2- factor interactions are not negligible. Such designs are needed both for unresponse and multiresponse experiments. The presently known designs are usually of uneconomic size and therefore cumbersome. Here it is shown that for the 3n series, a necessary and sufficient condition that a design be of resolution IV (i.e. where main effects are estimable orthogonal to other effects) is that it be an orthogonal array of strength 3. Similar conditions are obtained for the (2 superscript m) x (3 superscript n) series. Author (TAB)

N70-18364# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DISTRIBUTION FUNCTION WHOSE MOMENTS ARE CLOSE TO THOSE OF THE NORMAL LAW
S. G. Maloshevskii 30 Apr. 1969 10 p refs Transl. into ENGLISH from Mat. Zametki, (USSR), no. 2, 1967 p 627-633
(AD-696516; FTD-HT-23-88-69) Avail: CFSTI CSCL 12/1

The distance is estimated in a uniform metric between two distribution functions, one of which is normal, from the given distances between their corresponding moments (up to a certain order). This result is used to estimate the distance in a uniform metric from a set of all normal distribution functions to each of two distribution functions whose composition moments are close to the corresponding moments (up to a certain order) of the normal law. Author (TAB)

N70-18393# RAND Corp., Santa Monica, Calif.
TWO TO THE NTH POWER MINUS 21,382,107,400,956,509,849 IS NEVER A PRIME
Joel Spencer Oct. 1969 4 p
(AD-696113; P-4229) Avail: CFSTI CSCL 12/1

Logical proof that the sequence 2 to the nth power minus a is never a prime is demonstrated. Proof includes a factorization table showing 2 to the 32nd power + 1 first found by Fermat, the solution of which is given in the title. By use of the Chinese remainder theorem and Dirichlet's theorem, 2 to the nth power is always divisible by one of the seven primes but the residue class

contains an infinite number of primes. Taking a negative and large 2 to the nth power minus a never equals any of the primes and so is never a prime. Author

N70-18397# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
CONSTANT DIRECTIONS OF THE RICCATI EQUATION
David Rappaport (Ph.D. Thesis) Aug. 1969 41 p refs
(Grant AF-AFOSR-1244-67)
(AD-696156; AFOSR-69-2687TR) Avail: CFSTI CSCL 12/1

An examination is made of the Riccati equation occurring in the optimization of a linear discrete-time autonomous free-control (noise-free) quadratic regulator with a scalar input, or equivalently by the duality of optimal control and optimal filtering problems, that Riccati equation arising in the optimal filtering of a linear discrete-time autonomous augmented-state system driven by Gaussian white noise being observed by a noiseless scalar output (the colored noise problem). The research problem is defined as a search for constant directions of the Riccati equation. A constant direction is a direction in which the Riccati equation reaches an equilibrium point in a finite time interval. Each such direction corresponds to a reduction in the dimension of the Riccati iteration. Necessary and sufficient conditions for the existence of constant directions are determined. These conditions comprise linear relations between the inner products of the system moments. It is shown that the existence of constant directions implies that in these directions dead-beat controls are optimal. In the dual optimal filtering problem constant directions are shown to correspond to a tapped delay line with constant tap gains. Author (TAB)

N70-18398# Boeing Scientific Research Labs., Seattle, Wash.
FIBONACCI SEARCH WITH ARBITRARY FIRST EVALUATION
Christoph Witzgall Sep. 1969 31 p refs
(AD-696295; DI-82-0916; Rept-625) Avail: CFSTI CSCL 12/1

The Fibonacci search technique for maximizing a unimodal function of one real variable is generalized to the case of a given first evaluation. This technique is then employed to determine the optimal sequential search technique for the maximization of a concave function. Author (TAB)

N70-18457# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A GRADIENT METHOD OF SOLVING ONE CLASS OF OPTIMAL CONTROL PROBLEMS
O. V. Vasilev 25 Aug. 1969 18 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 7, no. 1, 1967 p 52-61
(AD-696227; FTD-HT-23-158-68) Avail: CFSTI CSCL 12/1

The article deals with the problem of minimizing the mean-square value of a part of the components of the final state of an object whose motion is described by a linear system of ordinary differential equations with initial conditions. The problem is solved under the condition that the remaining components of the final state of the object go through a specified point manifold. By making use of several premises of functional analysis, and extending a method first described by R. Gabasov and F. M. Kirillova, the problem is reduced to that of determining the maximum of a certain convex function of a finite number of variables, which play the role of the initial values of the vector of a conjugate system. The search is carried out by a gradient method which is analogous in a certain sense with the method of steepest ascent. Author (TAB)

N70-18485# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
LEAST-SQUARES FILTERING AND SMOOTHING FOR LINEAR DISTRIBUTED PARAMETER SYSTEMS
J. S. Meditch Aug. 1969 24 p refs *Its* Inform. Sci. Lab. Report No. 36
(AD-696277; D1-82-0895) Avail: CFSTI CSCL 9/4

The problem of estimating the state of a class of linear distributed parameter systems from noisy measurements is considered from the viewpoint of weighted least-squares estimation over the spatial domain of the system and the time interval of the measurement data. The problem is reduced to a two-point boundary-value problem via the calculus of variations. The two-point boundary-value problem is then solved in closed form via the sweep method to obtain a Kalman-Bucy type filter. Solution of the smoothing problem then follows directly. Cases are considered where measurement data are obtained over the entire spatial domain of the system or at discrete points in this domain, and where the system is subject to internal and external disturbances as well as measurement errors. Some resulting problems for future study are discussed. Author (TAB)

N70-18472# Boeing Scientific Research Labs., Seattle, Wash.
THE NUMBER OF PLANAR TREES
David W. Walkup Sep. 1969 12 p refs *Its* Math. Note No. 524
(AD-696413; D1-82-0914) Avail: CFSTI CSCL 12/1

By a planar tree is meant a realization of a tree in the plane, and by an isomorphism between two planar trees is meant a mapping which is not only an isomorphism in the usual sense of trees but which also preserves the clockwise cyclic order of edges about each node. Explicit formulae are given for each of the following: (1) the number of nonisomorphic unrooted planar trees with n edges, (2) the number of nonisomorphic rooted planar trees with n edges, and (3) the number of nonisomorphic rooted planar trees with n edges such that the root is incident on exactly k edges, of which one is distinguished. Author (TAB)

N70-18474# Boeing Scientific Research Labs. Mathematical Research Lab.
RANGE-DOMAIN IMPLICATIONS FOR CONCAVE OPERATORS
Johann Schroeder Oct. 1969 28 p refs *Its* Math. Note No. 627
(AD-697062; D1-82-0927) Avail: CFSTI CSCL 12/1

Let R and S denote linear spaces and M:R(arrow)S an operator which is concave in some rather general sense. Sufficient conditions are derived such that an element u epsilon B included in R belongs to a certain set K included in R whenever Mu is contained in some given set C included in S. Results of an earlier paper on linear operators are generalized in different ways. For example, the set K may have empty interior. There is also given a generalization of the matrix class M of Fiedler and Ptak. Some examples are concerned with operators in the Hilbert Space l sub 2. Author (TAB)

N70-18476# Wisconsin Univ., Madison. Mathematics Research Center.
SOME EFFECTS OF TCHEBYCHEFFIAN SPLINE FUNCTIONS
George S. Kimeldorf and Grace Wahba Feb. 1969 22 p refs
(Contract DA-31-124-ARO-(D)-462)
(AD-696321; MRC-TSR-965) Avail: CFSTI CSCL 12/1

The report derives explicit solutions to problems involving Tchebycheffian spline functions. A reproducing kernel Hilbert space is used which depends on the smoothness criterion, but not on the form of the data, to solve explicitly Hermite-Birkhoff interpolation and smoothing problems. Sards best approximation to linear functionals and smoothing with respect to linear inequality constraints are also discussed. Author (TAB)

N70-18477# Innsbruck Univ. (Austria). Dept. of Mathematics.
DEVELOPMENT OF NEW METHODS FOR THE SOLUTION OF DIFFERENTIAL EQUATIONS BY THE METHOD OF LIE

SERIES Final Technical Report, Jun. 1968-Jul. 1969
W. Groebner, K. H. Kastlunger, H. Reitberger, R. Saely and G. Wanner Jul. 1969 159 p refs
(Contract DAJA-37-68-C-1199)
(AD-696495) Avail: CFSTI CSCL 12/1

The report summarizes the recent work in the application of the LIE-series method to the solution of ordinary and partial differential equations. The power series method which is a special case of the Lie series method of chapter III is described in chapter II. Chapter III deals with the numerical evaluation of the Lie series perturbation formula. In chapter IV we prove Grobners integral equation which leads to short proofs of the formulas of chapter III and to various generalizations of the method. A survey of these is presented at the end of this summary. Chapter V generalizes the concept of Runge-Kutta to methods with multiple nodes, which is possible with the use of the Lie differential operator D. Chapter VI deals with the step-size control and chapter VII shows the application of generalized Lie series to the calculation of switch-on transients occurring in the telegraphic equation. TAB

N70-18545# Stanford Univ., Calif. Dept. of Statistics.
TESTS FOR NORMALITY
M. A. Stephens 10 Nov. 1969 29 p refs Sponsored in part by the Natl. Res. Council of Can.
(Contract Nonr-225(52))
(AD-697289; TR-152) Avail: CFSTI CSCL 12/1

The paper gives percentage points for four goodness-of-fit statistics, of Kolmogorov-type; i.e., based on the comparison of empirical and theoretical distribution functions. The points are to be used for a test of normality, when mean and variances must be estimated from the data. Simple modifications of the statistics are also given, which make the tests very easy to apply. The statistics are compared for power with the W statistic; they compare much better than previously reported, and for certain long-tailed alternatives seem to be as good as the W-statistic. Author (TAB)

N70-18564# Stanford Univ., Calif. Dept. of Statistics.
ON RANDOM SEQUENTIAL PACKING IN THE PLANE AND A CONJECTURE OF PALASTI
B. Edwin Blaisdell and Herbert Solomon 19 Sep. 1969 63 p refs
(Contract Nonr-225(52))
(AD-697283; TR-148) Avail: CFSTI CSCL 12/1

A conjecture by Palasti on mean values for random packing is explored. After thorough experimental examination and with several theoretical results as anchor points, the conjecture is demonstrated to be incorrect. The mean packing density in two dimension is a little higher than the square of the mean density in one dimension. The conjecture for higher dimensions remains an open question but some work is presented to provide clues. Other issues arise in random packing of points on a lattice and these are developed. Author (TAB)

N70-18569# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
DIRECTIONAL DERIVATIVES IN CLASSICAL OPTIMIZATION
Jorge A. Marban Aug. 1969 154 p refs
(Contract DAHC04-68-C-0002)
(AD-696420; THEMIS-UF-TR-24) Avail: CFSTI CSCL 12/2

The use of directional derivatives in the solution of classical optimization problems was introduced. Directional derivatives provided a technique to approximate a function in a neighborhood of a point along a particular direction. With this approximation a complete and original analysis procedure of constrained optimization problems was developed. The study of classical optimization problems using directional derivatives not only provided a better computational technique for the solution of the problem, but also represented a unification in the theory of optimization. Author (TAB)

N70-18599# Bettis Atomic Power Lab., Pittsburgh, Pa.
ON THE SOLUTION OF THE TIME-DEPENDENT GROUP DIFFUSION EQUATIONS BY AN IMPLICIT TIME DIFFERENCED ITERATIVE METHOD
J. B. Yasinsky and L. A. Hageman *In* Am. Nucl. Soc. Proc. of the Conf. on The Effective Use of Computers in the Nucl. Ind. [1969] p 55-75 refs (See N70-18594 07-22)
Avail: CFSTI

The two dimensional space-time differencing method used in the TWIGL program is discussed. The space-time diffusion equations which are solved by the program are given. Use of the cyclic Chebyshev polynomial method for solution to the space-time equations is discussed. A numerical example is detailed; results of calculations are presented in graphic and tabular form. NSA

N70-18643*# Stanford Univ., Calif. School of Engineering.
APPROXIMATING PROPERTIES OF LINEAR MODELS FOR INPUT OUTPUT DESCRIPTIONS
Ernest Gunther Holzmann Mar. 1968 152 p refs
(Grant NGL-05-020-073)
(NASA-CR-108083) Avail: CFSTI CSCL 12A

Efforts to solve certain approximation problems that arise in the computation of linear stationary models of dynamical systems from given input-output data are presented. Mathematical proof is given that good dynamical simulation is possible with linear models which represent partial, rather than minimal, realizations. For any normal sequence of scalar Markov parameters, the transfer function of each partial realization is shown to lie on the diagonal of the E-array corresponding to the given sequence. The proof is based on the classical theory of the Padé approximation. Relevant parts of this theory are reviewed and developed including a new, stronger form of Padés representation theorem. A new algorithm expresses every minimal realization of a given sequence of Markov parameters in terms of the pseudo-inverse matrices. The generating matrices are familar from the theory of complete controllability and observability. The algorithm is shown to be the sharpest possible, subject ot the requirement that every minimal realization be obtainable. Author

N70-18648# Stanford Univ., Calif. Dept. of Operations Research.
A SIMPLEX-SEARCH ALGORITHM FOR SOLVING ZERO-ONE MIXED INTEGER PROGRAMS
Ronald E. Davis 13 Oct. 1969 66 p refs
(Contract Nonr-225(89); Grant NSF GP-7074)
(AD-697301; TR-16) Avail: CFSTI CSCL 12/2

An algorithm for solving zero-one mixed integer programming problems which has been developed and implemented in an all-in-core FORTRAN program is reported with computational experience on a variety of well-known problem types. The imbedded linear programs of Land and Doig, the derived binary constraints of Benders, and the binary feasibility tests introduced by Balas, are used in conjunction with augmented linear programs obtained by summarizing in the form of a linear inequality the set of solutions remaining to be (implicitly) enumerated when only partial completion of a branch-and-bound search has been accomplished. These augmented linear programs yield new sufficient conditions for optimality of an incumbent solution which have significantly accelerated convergence of the search procedure on a number of problem types, notably the Savage-Lorie project selection or multi-dimensional knapsack variety. Computational experience with scheduling, warehouse location, and economic investment planning models is also reported. The algorithm has proven satisfactory for use on a production basis, and is currently in use for selection of water resource development projects. Author (TAB)

N70-18649# Purdue Univ., Lafayette, Ind. Graduate School of Industrial Administration.
AN ALGORITHM FOR NONCONVEX PROGRAMMING
G. Graves and Andrew Whinston 5 Sep. 1969 21 p refs

(Contract N00014-67-A-0226-0006)
(AD-697316) Avail: CFSTI CSCL 12/2

An algorithm is presented for solving a generalized mathematical problem. The general formulation allows for nonlinear or linear integer programming and general nonconvex continuous variable programming. The extant algorithms for this general problem can usually be viewed as local search procedures. TAB

N70-18696# Stanford Univ., Calif. Dept. of Statistics.
G-PEAKEDNESS COMPARISONS FOR RANDOM VECTORS Technical Report
Govind S. Mudholkar 7 Nov. 1969 19 p refs Prepared in cooperation with Rochester Univ.
(Contract NONR-225(52); Grant NSF GP-8893)
(AD-697288; TR-151) Avail: CFSTI CSCL 12/1

The concept of G-peakedness is proposed as a generalization of Birnbaum's definition of peakedness comparisons of random variables and of an extension of this definition to random vectors by Sherman. TAB

N70-18697# Stanford Univ., Calif. Dept. of Statistics.
TECHNIQUES FOR DIRECTIONAL DATA Technical Report
M. A. Stephens 4 Nov. 1969 34 p refs Prepared in cooperation with Mc Gill Univ.
(Contract Nonr-225(52))
(AD-697287; TR-150) Avail: CFSTI CSCL 12/1

Statistical data in the form of directions may be recorded as two- or three-dimensional unit vectors from an origin O to points P on the circumference of a circle or the surface of a sphere. In recent years techniques have been developed to deal with such data, when the vectors are directed, i.e., have a preferred sense. This paper shows how the techniques may be adopted for use with axial data, i.e., vectors with no preferred sense, and also for bimodal directed data. Several practical illustrations are given. Author (TAB)

N70-18778# Stanford Univ., Calif. Dept. of Statistics.
ON A MONOTONE CHARACTER OF SOME INVARIANT STATISTICS
Govind S. Mudholkar 3 Nov. 1969 25 p refs
(Contract Nonr-225(52))
(AD-697286; TR-149) Avail: CFSTI CSCL 12/1

Some results on variations of distribution functions and moments of convex or concave statistics from certain populations with respect to population translation parameters are derived and their implications and applications are discussed. The results generalize similar results in Mudholkar. Author (TAB)

N70-18779# George Washington Univ., Washington, D.C.
AN INCREMENTAL TIME-EXPANDED NETWORK FLOW MODEL
Leonard H. Bruffey, Erling F. Rosholdt, and Ronald E. Stadick 30 Jun. 1969 21 p ref
(Contract N00014-67-A-0214)
(AD-697296; T-228) Avail: CFSTI CSCL 12/2

A static flow network expanded over time to obtain dynamic flows essentially involves almost as many replications of the basic network as there are time periods in the time span of interest. Computer models of these expanded networks have required long run-times because of the excessively large network files. The paper describes the implementation of a method for decreasing the computer processing time by reusing the temporally repeated arc-chain patterns of a smaller expansion of the basic static flow network. The procedure decreases the processing time of a test network by approximately 85% as compared to the processing time required for the same network fully expanded over the time span of interest. Author (TAB)

N70-18781# Stanford Univ., Calif. Dept. of Statistics.
SOME LOWER BOUNDS OF RELIABILITY
Tapas K. Sarkar 10 Aug. 1969 97 p refs
(Contract Nonr-225(53))
(AD-697292; TR-124) Avail: CFSTI CSCL 14/4

Consider a series system with n components. Let X sub i be the time to failure of the (i)th component. Let R(t) be the reliability of the system at time t and R*(t) be the reliability when the components are independent. It is desired to find physically meaningful conditions such that R*(t) is a lower bound of R(t) for all t. TAB

N70-18782*# Mathematical Sciences Group, College Park, Md.
IDENTIFICATION OF LINEAR SYSTEMS Final Report
Thomas S. Englar Jan. 1970 85 p refs
(Contract NAS12-583)
(NASA-CR-86322) Avail: CFSTI CSCL 12A

A description is given of the context of linear systems analysis in which the problem is formulated, making specific assumptions and the conditions the identified system must satisfy. There are two basic subdivisions of the system. These are: obtaining the impulse response from the input and output functions and obtaining a realization from the impulse response by application of the B. L. Ho algorithm. Author

N70-18790# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
CLUSTER ANALYSIS AND MATHEMATICAL PROGRAMMING
M. R. Rao Oct. 1969 29 p refs
(Contract Nonr-760(24))
(AD-697267; RR-183) Avail: CFSTI CSCL 12/1

Cluster analysis involves the problem of optimal partitioning of a given set of entities into a pre-assigned number of mutually exclusive and exhaustive clusters. Here the problem is formulated in two different ways with the distance function (a) of minimizing the within groups sums of squares and (b) minimizing the maximum distance within groups. These lead to different kinds of linear and non-linear (0-1) integer programming problems. Computational difficulties are discussed. Author (TAB)

N70-18793# Purdue Univ., Lafayette, Ind. Krannert Graduate School of Industrial Administration.
TWO ALGORITHMS FOR INTEGER OPTIMIZATION
Edna Loehman, Ph.T. Nghiem, and Andrew Whinston 5 Sep. 1969 34 p refs Sponsored in part by AROD
(Contract N00014-67-A-0226-0006)
(AD-697320) Avail: CFSTI CSCL 12/2

The paper presents two algorithms for solving zero-one programming problems. The algorithms are also suited for solving mixed integer programming problems, that is, when some of the variables are required to be zero or one but the other variables may take on any nonnegative value. The two algorithms are very similar in that both use the dual method to solve the associated linear programming problem. However, the tree search procedures used are different. In the first, the order of variables in a partial solution is fixed in backtracking. In the other, there is some flexibility in backtracking. Different choice procedures for selecting a variable to fix at zero or one are used. Computational results are presented. Author (TAB)

N70-18800*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE FULLY INDECOMPOSABLE MATRIX AND ITS ASSOCIATED BIPARTITE GRAPH: AN INVESTIGATION OF COMBINATORIAL AND STRUCTURAL PROPERTIES
Edwin Joseph Roberts (Ph.D. Thesis - Houston Univ.) Jan. 1970 97 p refs
(NASA-TM-X-58037) Avail: CFSTI CSCL 12A

For any n×n (0,1) matrix A, a correspondence is established

between A and a certain bigraph G. Equivalences between various concepts pertaining to A and G, respectively, are demonstrated. It is shown that if A is fully indecomposable, then G is 2-connected. A method is developed for reducing a bigraph G of a nearly decomposable matrix to a strictly smaller bigraph G', which is also associated with a nearly decomposable matrix A'. This result is used to completely characterize the fully indecomposable matrices in terms of their bigraphs and leads to a lower-bound estimate for the permanent function on this class of matrices. Finally, the characterization theorem is shown to be relevant to the problems of: (1) finding an upper-bound estimate for the permanent, and (2) of determining the structure of the class of nearly decomposable matrices. Some partial results along these lines are given. Author

N70-18803# Harvard Univ., Boston, Mass. Graduate School of Business Administration.
STATISTICAL ANALYSIS AND DESIGN OF EXPERIMENTS Final Scientific Report, 1 Sep. 1966-31 Aug. 1969
George E. P. Box and George C. Tiao Oct. 1969 6 p refs
(Contract AF 49(638)-1608)
(AD-696237; AFOSR-69-2735TR) Avail: CFSTI CSCL 12/1

Three books have been completed with the aid of the contract: Evolutionary Operation; Time Series Analysis, Forecasting and Control; and, Bayesian Inference. The report gives a brief discussion of the books. TAB

N70-18805# Auburn Univ., Ala. Computer Center.
POLYNOMIAL MANIPULATION SYSTEM: FORTRAN 4 PROGRAM
Leland H. Williams and James R. Sidbury Nov. 1969 24 p refs
(Contract DAAH01-68-C-0296; Proj. THEMIS)
(AD-697152; THEMIS-AU-T-6) Avail: CFSTI CSCL 9/2

A FORTRAN IV program which implements the Polynomial Manipulation System (PMS) is presented and described. PMS uses the Euclidean algorithm to reduce a system of polynomials in several variables to a resultant system which can be solved sequentially as polynomials in one variable (Kroneckers method). PMS is described briefly and references are given to more complete discussions and to other pertinent literature. Author (TAB)

N70-18813# Purdue Univ., Lafayette, Ind. Krannert Graduate School of Industrial Administration.
A FLEXIBLE TREE SEARCH METHOD FOR INTEGER PROGRAMMING PROBLEMS
Ph. Tuan Nghiem 5 Sep. 1969 31 p refs
(Contracts N00014-67-A-0226-006; DA-31-124-ARO(D)-477)
(AD-697317) Avail: CFSTI CSCL 12/2

The paper presents an enumerative method for solving integer programming problems and an algorithm implementing this method. Whereas the enumerative methods so far available closely follow the pattern used in counting numbers, underlying the proposed method is a more flexible scheme. In the former case, numbers are enumerated by modifying the digits from the rightmost, leftward. In the latter, the choice of a digit to be modified is allowed a greater degree of freedom: the technique amounts to reshuffling, at each stage, the ranks of the digits in a certain set. Author (TAB)

N70-18822 Cornell Univ., Ithaca, N.Y.
SPECTRAL REPRESENTATION OF SIGNALS AND LINEAR TIME-VARYING NETWORKS
Gagan S. Mirchandani (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-7397

The representation and synthesis of time-varying networks is investigated from a generalized frequency point of view. A characterization and algebra is developed for time-varying networks with arbitrary variations. The characterization is used to generate synthesis procedures. It is shown that this leads to a time-variable counterpart of the theorem of Foster. The representation of signals in a generalized frequency basis is examined and it is shown that linear causal time-varying filters can be designed to separate signals and to optimize the separation, when complete separation is not possible. Dissert. Abstr.

N70-18830 Syracuse Univ., N.Y.
THE CLASSIFICATION OF LOGIC FUNCTIONS
Paul Kingsley Blackwell, II (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-7718

The classification problem for logic functions is the problem of deciding whether two k-valued logic functions of n k-valued variables are equivalent under the operations of complementing and permuting variables and complementing the functions. The problem is solved here for all integral k and presented as an algorithm. The algorithm assigns to each equivalence class of logic functions a canonical representative and thereby reduces the classification problem to a comparison of the representatives. It is also shown that the transform matrices have the Hadamard property. Finally, it is shown that in deciding equivalence of functions it is computationally more efficient to precompute the spectral component of order zero than to compute the entire spectrum at the outset, but that if the computation is to be made in only two steps it is not advantageous to precompute more than nk spectral components. Dissert. Abstr.

N70-18842# Weapons Research Establishment, Salisbury (Australia). Dept. of Supply.
A NEW MODEL OF A SYMMETRIC UNIVERSE BASED ON INFORMATION THEORETIC CONCEPTS, WHICH CAN BE TESTED USING LASER TECHNIQUES
Alma Werner and J. L. Hughes Oct. 1969 21 p refs
(WRE-TN-CPD-167) Avail: CFSTI

The mathematical foundation for a new symmetric model of the universe based on information theoretic concepts is outlined. Conditions are given to test the validity of the new theory in the laboratory using intense, focused laser beams. Author

N70-18845 Case Western Reserve Univ., Cleveland, Ohio.
CHARACTERIZATIONS OF METRIC SPACES BY THE USE OF THEIR MIDSETS
Anthony Dwight Berard, Jr. (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-9391

In the case where n = 1, the hypothesis is weakened, and a connected metric space with the unique midpoint property is homeomorphic to an interval of the reals. By proving a fact similar to this about the space, X is a diameterized metric space each of whose midsets is a complete convex metric space with the double midpoint property, then X is homeomorphic to S-2. Dissert. Abstr.

N70-18855 Virginia Polytechnic Inst., Blacksburg.
EULER SETS IN E TO THE NTH POWER
Peter Argentiero (Ph.D. Thesis) 1968 50 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9922

An S-map from a metric space X into a metric space Y is a map f such that there exists a 0 less than or equal K less than or equal 1 and for all x and y epsilon X, d[f(x),f(y)] = K[d(x,y)]. The set of S-maps S(X) on a compact set X under the compact-open topology and under composition is a topological semi-group. If X is a starlike subset of E to the nth, S(X) is arcwise connected. Using the topological and algebraic properties of S(X), we show that if X is a starlike subset of E to the nth, there exists a continuous transformation from C(X) onto [0,1]. An S-homotopy

on X (a compact metric space) is a homotopy H:X x I yields X such that H:X x 0 yields X is the identity map on X and H:X x 1 yields X is a contractive S-map. Also for all T epsilon I, H:X x T yields X is an S-map. Dissert. Abstr.

N70-18876 North Carolina Univ., Chapel Hill.
THE ISOTOPY TYPE OF CERTAIN FINITE POLYHEDRA
Stanley Ray Clemens (Ph.D. Thesis) 1968 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10142

Several isotopy invariants deal with the problem of distinguishing homotopically equivalent spaces. For each pseudomanifold M, a collection of spaces D sub M is described. Involved in this description is the notion of (p,k)-branch simplex, and it is shown that for each pair of positive integers, (p,k), the cardinal number of (p,k)-branch simplexes is an isotopy invariant with respect to the collection D sub M. This isotopy invariant is then used together with the isology groups of A. H. Copeland to show that certain spaces in D sub M are not isotopically equivalent. Finally, a new isotopy functor is defined, and composition of this functor with the homology functor yields a homology theory of an isotopy functor. The usefulness of these groups is compared with other groups found in the literature. Dissert. Abstr.

N70-18905 Princeton Univ., N.J.
PARTIALLY SOLVABLE AND ALMOST SOLVABLE PROBLEMS
Dionysios C. Tsichritzis (Ph.D. Thesis) 1968 135 p
Avail: Univ. Microfilms: HC $5.40/ Microfilm $3.00 Order No. 69-10528

In this work, a positive approach towards unsolvability is chosen. The equivalence problem is chosen as representative. It is proved to be unsolvable for the class L sub 2 of primitive recursive functions. A solution is given for the class of functions L sub 1. Further a set of other important problems not directly connected with the equivalence problem is investigated. These problems are found again to be unsolvable for the class L sub 2; but as before, a solution is given for the class L sub 1. It is concluded, therefore, that there is a barrier of unsolvability between the classes of L sub 1 and L sub 2. It is evident that a class of functions where many problems can be effectively solved is a very small class indeed. For some of these problems a solution, even approximate, is needed. It is pointed out that, although machines are deterministic in nature, humans are not; humans can base their decisions on rather fuzzy and approximate criteria. Fuzzy properties and relations are defined on countable sets and a notion of fuzzy computability is obtained. Hierarchies of functions based on approximate behavior are defined and their complexities compared. Finally, statistical properties and decisions are discussed. Dissert. Abstr.

N70-18924*# Massachusetts Univ., Amherst. Engineering Research Inst.
MINIMAX DESIGN OF LOW SENSITIVITY FILTERS FOR STATE ESTIMATION
Joseph Anthony D'Appolito (Ph.D. Thesis) 1970 144 p refs
(Grant NGR-22-010-012)
(NASA-CR-108204; TR-4) Copyright. Avail: CFSTI CSCL 12A

A general approach to the design of linear filters for state estimation when large uncertainties in plant and measurement parameters are present is given. The case of uncertain noise statistics is fully explored and several examples are presented to illustrate the utility and practicality of the approach. Author

N70-18928 Yale Univ., New Haven, Conn.
FREQUENCY DOMAIN METHODS FOR THE STABILITY ANALYSIS OF NONLINEAR AND TIME-VARYING FEEDBACK SYSTEMS
Yo-Sung Cho (Ph.D. Thesis) 1968 155 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-8329

A passive operator technique is proposed to study the stability of continuous and discrete feedback systems consisting of a linear time-invariant part G in the forward path and a linear or nonlinear time-varying gain function in the feedback path. Using this technique, classes of multipliers Z are generated which together with the nonlinear or time-varying gain functions satisfy certain passivity conditions. A sufficient condition for the stability of a system containing a corresponding class of nonlinear or time-varying elements is that Z.G be P.R. (positive real). For discrete systems containing a nonlinear or time-varying element, methods similar to those used in continuous cases are applied to obtain frequency domain stability criteria. New multipliers M(z) are generated and geometrical stability criteria are derived. Dissert. Abstr.

N70-18942# Harvard Univ., Cambridge, Mass. Dept. of Statistics.
THE METHOD OF SPECIAL CASES IN COMBINATORIAL THEORY AND PROBABILITY
Jay R. Goldman 24 Oct. 1969 15 p refs
(Contract N00014-67-A-0298)
(AD-697305; TR-28) Avail: CFSTI CSCL 12/1

Renyi has given a very simple and elegant approach to proving inclusion-exclusion relations. We reformulate Renyis method as a theorem on non-negative additive set functions on finite sets. The set is then assumed to be partially ordered and the theorem is applied to prove the Mobius inversion formula. In analogy with results on the lattice of subsets we are led to conjecture and prove relations for other partially ordered sets in particular the lattice of subspaces of a finite vector space and the lattice of partitions of a set. Author (TAB)

N70-18950# Carnegie-Mellon Univ., Pittsburgh, Pa. Management Sciences Research Group.
MINIMAX AND DUALITY FOR LINEAR AND NONLINEAR MIXED-INTEGER PROGRAMMING
Egon Balas Jun. 1969 59 p refs Presented at NATO Advanced Study Inst. on Integer and Nonlinear Programming, Bendor, France, 8-20 Jun. 1969
(Contract Nonr-76(24))
(AD-697306; RR-176; WP-9-69-7) Avail: CFSTI CSCL 12/2

The paper discusses duality for linear and nonlinear programs in which some of the variables are arbitrarily constrained. The most important class of such problems is that of mixed-integer (linear and nonlinear) programs. The paper introduces the duality constructions and discusses algorithms based on them. Author (TAB)

N70-19016 Syracuse Univ., N.Y.
NONPARAMETRIC SIGNALS AND DETECTORS
Noble Robert Powell (Ph.D. Thesis) 1968 178 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 69-8644

A study of decision techniques which may achieve prescribed error performance irrespective of the probability distributions of physical observations is presented. An examination is made of a particular example of a class of two-sample, or two input, nonparametric detectors. These involve the use of order statistics to increase detector sensitivity to selected percentiles and incorporate a component sample-process to estimate distance parameters in the space of prevalent probability distributions. The development suggests a systematic approach to the design of such detectors. The relative effectiveness of two different component data-processes is measured in terms of the sample sizes required for each to detect certain nonparametric signals and to detect certain parametric signals. The results indicate that this relative performance depends

both upon the generality of the class of admissible probability distributions and upon the closeness of the signal distributions to the no-signal distributions for large and small signal-to-noise ratios.
Dissert. Abstr.

N70-19017 Carnegie-Mellon Univ., Pittsburgh, Pa.
AN ORTHONORMAL OPTIMIZATION ALGORITHM WITH APPLICATIONS
Nels Anders Broste (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-7898

An analytical basis for and applications of an optimization technique for solving least-squared-error problems (and others) involving complex nonlinear error functions with many parameters is presented. The technique is an iterative process based on a solution of a system of linearized equations in the parameters. If the linearization is exact and the performance index quadratic, convergence is guaranteed in a finite number of iterations. Modifications have been implemented for improving the performance of the optimization process when the performance index is nonquadratic. The effect of these modifications on convergence is analyzed. The process is extended to solve optimal control problems with constraints. Several examples are given which illustrate the application of the optimization process to a wide variety of problems.
Dissert. Abstr.

N70-19022 Case Western Reserve Univ., Cleveland, Ohio.
INTERNAL COMPACTIFICATIONS OF TOPOLOGICAL SPACES
Frank William Lozier (Ph.D. Thesis) 1968 62 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-9421

Several questions about the internal compactifications (one-to-one compact images) of completely regular spaces are considered. First, the internal compactifications of a space are characterized in terms of decompositions of a compactification of the space, and certain subsets of the space which are related to the structure of a given internal compactification are defined. Then the question of the existence of internal compactifications is considered in terms of the standard topological operations and relations. Next, conditions under which a space with an internal compactification has enough to determine its topology are investigated; it is shown that any space which has its topology determined by its homeomorphisms has this property. Finally, for any space which has its topology determined by its internal compactifications, the question of whether the natural compactification determined by its internal compactifications is in fact the Stone-Cech compactification is considered; this is shown to be the case for any locally compact space which either is 0-dimensional or contains an arc.
Dissert. Abstr.

N70-19023 California Univ., Berkeley.
ELEMENTARY SOLUTIONS OF PARTIAL DIFFERENTIAL OPERATORS WITH CONSTANT COEFFICIENTS
Narendra Lal Maria (Ph.D. Thesis) 1968 93 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 69-10343

After preliminaries on distributions, convolutions, and elementary solutions, an equivalence is established between the distribution problem in a half space/the Cauchy problem, of a linear partial differential operator, and a distribution equation over R(n+1). In this context it is shown how one can get an elementary solution with support in the half space x sub o greater than or equal to 0 of the general linear partial differential operator with constant coefficients. Explicit elementary solutions are constructed for some differential operators of interest.
Dissert. Abstr.

N70-19062 California Univ., Berkeley.
SOME CLASSES OF QUASI-INVARIANT NON-GAUSSIAN RANDOM LINEAR FUNCTIONALS IN HILBERT SPACE
Ali Mohammad Tabatabaian-Kashani (Ph.D. Thesis) 1968 52 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10394

Certain classes of random linear functionals are constructed on Hilbert space which are realizable as measures on R (infinity). They are quasi-invariant under l(2)-translations R (infinity) but are not equivalent to any Gaussian random linear functional. Conditions are obtained for additive quasi-invariance of product measures on infinite product spaces. The results are used to find conditions for multiplicative quasi-invariance of product measures. Quasi-invariant (additive) product measures are used to construct quasi-invariant random linear functionals on Hilbert space. Conditions are obtained for the random linear functional to be equivalent to no Gaussian one. Specific examples of quasi-invariant non-Gaussian random linear functionals are given. It is shown that the random linear functionals defined by these products are non-Gaussian.
Dissert. Abstr.

N70-19067 Case Western Reserve Univ., Cleveland, Ohio.
THE STATE IDENTIFICATION OF A CLASS OF DISTRIBUTED SYSTEMS
Gordon Adolph Phillipson (Ph.D. Thesis) 1968 239 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.10 Order No. 69-9431

The problem of state identification of a distributed system is phrased as a variational problem, that of minimizing a Quadratic functional on an appropriate Hilbert space. The systems considered are those described by linear parabolic and second order hyperbolic partial differential equations. A variety of state identification problems associated with these systems are posed. The solutions of these variational problems are characterized by canonical sets of equations, obtained by invoking a specialized maximum principle derived from the theory of variational inequalities. These canonical equations are of a special type and consideration is given to two methods of obtaining numerical solutions, one of which proceeds via a Ricatti-like decoupling, the other being an iterative technique involving conjugate directions of search on a quadratic error surface. The proposed numerical schemes are carried out on an illustrative example.
Dissert. Abstr.

N70-19069 Syracuse Univ., N.Y.
EXPONENTIAL FUNCTION SETS IN THE ANALYSIS OF NONLINEAR SYSTEMS
Gerald James Kirwin (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-7751

An approximate solution for the response of the system to a transient (i.e., nonperiodic) input signal is proposed. The systems under consideration are single loop control systems having a linear dynamic subsystem in tandem in the loop with a memory-free nonlinear subsystem. An approximating system is devised by replacing each signal with its projection on a subspace of square-integrable functions. The subspace to which all signals in the system are restricted is defined in relation to the linear subsystem. Signal components in the orthogonal complement of this subspace are disregarded. The transmission of signals in the subspace through the nonlinear part of the system is expressed by a multidimensional equivalent gain function. This gain function is introduced in the dissertation as a generalization of the well-known sinusoidal describing function. The effect of the linear part of the system on the subspace signals is taken into account using a (linear) transfer function matrix.
Dissert. Abstr.

N70-19070 Cornell Univ., Ithaca, N.Y.
CONTRIBUTIONS TO THE METHODOLOGY OF DECOMPOSITION AND FIXED CHARGE PROBLEMS
Warren Elliot Walker (Ph.D. Thesis) 1968 102 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-5780

Two areas of mathematical programming (1) the decomposition of large linear programs and (2) linear programs with fixed costs are discussed. An algorithm is developed which uses modifications of the Dantzig-Wolfe decomposition principle and Wolfe's Generalized Linear Programming in a hierarchical combination. The algorithm is applied to a problem of loading and dispatching cargo aircraft. Computer results for this application are given. A method is developed to obtain the set of optimal dual variables for a linear program which has been solved by the Dantzig-Wolfe decomposition technique. The fixed charge problem is discussed and three approximate algorithms are presented. The algorithms yield very good and computationally efficient solutions to a set of test problems. Computational results are compared with earlier methods. It is shown that problems with separable piecewise-linear concave cost functions can be formulated as fixed charge problems.
Dissert. Abstr.

N70-19080 Iowa State Univ. of Science and Technology, Ames.
CONTRIBUTIONS TO THE THEORY OF ESTIMATION IN THE GENERAL LINEAR MODEL
Frank Burke Martin (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9875

This work contains three loosely joined topics which present, in order, contributions to the theory of best linear unbiased estimation in the general linear model, the combination by simple weighting of such estimators (b.l.u.e.s) from several independent sets of data, and the construction of classes of incomplete block designs having within block replication for estimation of sigma to the 2nd power and various degrees of balance but, in any case, simple analysis.
Dissert. Abstr.

N70-19099 California Univ., Berkeley.
AUTOMATED NETWORK DESIGN: PRINCIPLES AND TECHNIQUES
Stephen William Director (Ph.D. Thesis) 1968 276 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.55 Order No. 69-10279

The principles and techniques of parameter optimization are employed to formulate algorithms for the dc, frequency domain, and time domain design of linear, time-invariant networks. These design algorithms rely on effective, and efficient, calculation of the sensitivity of any scalar network function with respect to tall network parameters-including topology. Tellegen's theorem is employed to show the sensitivity in question may be ascertained by merely performing two network analyses: one on the original network and another on the related "mutually-reciprocal" adjoint network. The extension of these algorithms to design of nonlinear, time-variable, networks is shown to rely solely on the ability to calculate the appropriate sensitivities and adjoint networks. Consideration is given to a class of networks that contain nonlinear, time-varying elements having parametric representations.
Dissert. Abstr.

N70-19100 Wisconsin Univ., Madison.
ANALYSIS AND DESIGN OF INPUT PERTURBATION EXTREMUM SEEKING SYSTEMS
Gary Joseph Foley (Ph.D. Thesis) 1968 277 p
Avail: Univ. Microfilms: HC $12.60/Microfilm $3.60 Order No. 68-15978

The input perturbation extremum seeking system is introduced as the class of adaptive control most applicable in the operation of chemical processes. This optimizer maintains process operation at the extremum of a unimodal non-linear objective function. The design of the univariable and dual variable optimizer configuration is discussed as are suggestions for determination of useful parameter values. The presence of interaction in the dual variable objective function is shown to intercouple the adaptive loops, resulting in less desirable optimizer response. Elimination of the interaction and decoupling of the loops is accomplished through canonical transformation. High quality band pass filtering is recommended for reduction of the detrimental interloop interference which results from the presence of two perturbation signals.
Dissert. Abstr.

N70-19102 Yale Univ., New Haven, Conn.
WEAK ALMOST PERIODIC FUNCTIONS ON SEMIGROUPS
Robert Bruce Burckel (Ph.D. Thesis) 1968 126 p
Avail: Univ. Microfilms: HC $6.20, Microfilm $3.00 Order No. 69-8326

We consider singly continuous topological semigroups S and functions in C(S), the bounded continuous functions on S, which have relatively (weak) compact orbits and call them (weak) almost periodic, noting the respective classes W(S), A(S). In Chapter I we present the details of the Deleeuw-Glicksberg (weak) almost periodic compactification of S and use this compactification (SW) SA to derive quickly the elementary Banach algebra properties of (W(S)) A(S). Then, taking advantage of a recent fixed point theorem, we show that W(S) admits a translation invariant mean if S is a group or even a maximal subsemigroup of a group.
Dissert. Abstr.

N70-19117 Catholic Univ. of America, Washington, D.C.
THE "ADJOINT" IN LINEAR FUNCTIONAL DIFFERENTIAL EQUATIONS
John William Bessman, Jr. (Ph.D. Thesis) 1968 45 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-8890

A basic consideration in the study of differential equations is the behavior of the solution operator associated with various systems of linear differential equations with constant and periodic coefficients. The solution operator acts in the space of initial conditions and is used to express solutions to the given system of equations. The stability of the system is governed by the rate of growth of this operator. Conditional stability results come via a reduction of the initial value space using the eigenvalues of the so-called period map. In order to split off the eigenmanifolds of the period map, one requires the projections on these manifolds. In functional analysis such projections are derived in most circumstances by use of the adjoint to the operator in question. However, in applications one is required to construct these projections or, equivalently, to characterize the eigenmanifolds of the adjoint.
Dissert. Abstr.

N70-19164 Nebraska Univ., Lincoln.
BOUNDARY VALUE PROBLEMS FOR SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS
Gene Allen Klaasen (Ph.D. Thesis) 1968 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-9626

Let f(x,y,y') be defined and continuous on I × R to the 2nd power where I is an interval of the real line R. Solutions to the given boundary value problem depend on the given pair of boundary values. Also of interest is the investigation of sufficient conditions which, when imposed upon the given solutions, guarantee the global existence of solutions to the given boundary value problem.
Dissert. Abstr.

N70-19165 Rutgers Univ., New Brunswick, N.J.
PIECEWISE LINEAR APPROXIMATION OF A HOMEOMORPHISM FROM ONE COMBINATORIAL MANIFOLD INTO ANOTHER
Harry William Berkowitz (Ph.D. Thesis) 1968 81 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-7523

An important problem in topology is the approximation of a topological mapping, in this case a homeomorphism, by a mapping with special properties, in this case a piecewise linear homeomorphism. The piecewise linear mapping can then be used

to investigate the original mapping since the piecewise linear mapping has stronger properties than the original. If 4 m < or = to 3n - 5 and is a homeomorphism of a combinatorial closed m-manifold M(m) into a combinatorial n-manifold N(n), than for any epsilon > o, there exists a piecewise linear homeomorphism such that d(f,h) < epsilon. Dissert. Abstr.

N70-19161 Wisconsin Univ., Madison
ON THE BOUNDARY CONTROLLABILITY OF NONLINEAR HYPERBOLIC SYSTEMS
Mario Aurelio Cirina (Ph.D. Thesis) 1968 156 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 68-15974

Sufficient conditions for the extension of the local solution of a Cauchy problem to a strip of preassigned width are submitted. Analogous results for the nonlinear Goursat and initial boundary value problems are given and these results are used to solve controllability problems of nonlinear hyperbolic systems. The computation of boundary controls and some numerical results for a nonlinear string equation are given. Dissert. Abstr.

N70-19164 New Mexico Univ., Albuquerque.
SZEGOE LIMIT THEOREMS FOR TOEPLITZ OPERATORS ASSOCIATED WITH THE HANKEL TRANSFORM
George Gregory Stephen (Ph.D. Thesis) 1969 48 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9267

Analogs are developed for the Hankel transform of the weak and strong Szego limit theorems. These theorems have been proved previously in a Fourier transform setting and for Toeplitz matrices associated with ultraspherical polynomials.
Dissert. Abstr.

N70-19165 New Mexico Univ., Albuquerque.
RESPONSE OF A NONLINEAR SYSTEM TO RANDOM VIBRATION
James Darrell Gibson (Ph.D. Thesis) 1968 128 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-9244

Response statistics are obtained for a nonlinear, single-degree-of-freedom system subjected to a Gaussian, white noise random excitation. The system has nonlinear damping as well as nonlinear stiffness. The stationary joint probability density function is obtained as the numerical solution to the appropriate Fokker-Planck equation for the nonlinear system being considered. The first order probability density function, the mean square displacement, the average frequency of the response, and the average number of crossings of an aribtrary displacement level are subsequently obtained. These response statistics are compared with those obtained experimentally by simulating the nonlinear system under investigation on a solid state analog computer and exciting it with a random noise generator. The method of solution can be easily applied to engineering design problems. Dissert. Abstr.

N70-19169# Oak Ridge National Lab., Tenn.
SAMPLE SIZE REQUIREMENTS: TESTS OF EQUALITY OF SEVERAL GAUSSIAN MEANS
Marvin A. Kastenbaum, David G. Hoel, and K. O. Bowman Nov. 1969 36 p refs
(Contract S-7405-eng-26)
(ORNL-4468) Avail: CFSTI

Answers to questions concerning adequate sample size in a one-way analysis of variance situation depend on such things as the number of categories to be compared, the levels of risk an experimenter is willing to assume, and some knowledge of the noncentrality parameter. Tables are presented for the experimenter who can deal better intuitively with an estimate of the standardized range of the means than with the noncentrality parameter. Maximum values of the standardized range, tau are tabulated when the means of K groups, each containing N observations, are being compared at alpha and beta levels of risk, for alpha = 0.01, 0.05, 0.1, 0.2; beta = 0.005, 0.01, 0.025, 0.05, 0.1, 0.2, 0.3, 0.4; k = 2(1) 6; N = 2 (1) 30 (5) 50 (10) 100 (50) 200 (100) 500 (500) 1000. Author (NSA)

N70-19189 California Univ., Berkeley.
SMOOTHING AND APPROXIMATION OF FOLIATIONS
Maurice Cohen (Ph.D. Thesis) 1968 26 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-10268

Two foliations on a manifold M are C-O-conjugate (respectively C-1-conjugate) if there exists a homeomorphism (respectively a C-1 diffeomorphism) h:M approaches limit of M such that h maps the leaves of F onto the leaves of F'. The problem of approximating a C-r foliation F by a C-r' foliation F', r' greater than r greater than O, with F' C-O-conjugate or C-1-conjugate to F is considered.
Dissert. Abstr.

N70-19202 New Mexico Univ., Albuquerque.
THE QUALITATIVE BEHAVIOR OF SOLUTIONS OF NONLINEAR SECOND ORDER DIFFERENTIAL INEQUALITIES
Hugo Teufel, Jr. (Ph.D. Thesis) 1968 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-9269

The qualitative behavior of the solutions of several classes of second order nonlinear differential inequalities are examined. Cases in which the inequality sign is reversed and in which the inequality is strict are considered. Behavior of solution is, of course, dependent on the properties of the function F(t,x,x') and throughout the dissertation strongly nonlinear inequalities are primary. However, often the results hold for linear inequalities. The first set of theorems is concerned with the classification of the behavior of solutions of differential inequalities which generalize the classical linear second order differential equation. The solutions are shown to be either oscillatory or (eventually) monotone and their properties are given. In many cases it is not possible to determine which of these behaviors (oscillation or monotonicity) pertains for a given solution. However, by placing suitable restrictions on the nonlinearity, F(t,x,x'), it is sometimes possible to determine which behavior prevails. The counterpart idea for differential inequalities is explored. The results include a case where the nonlinearity N(x) is convex and increasing and a case where N(x) is decreasing.
Dissert. Abstr.

N70-19215 New York Univ., N.Y.
SOME IA AUTOMORPHISMS OF A FREE GROUP
Orin Nathaniel Chein (Ph.D. Thesis) 1968 123 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 69-7940

The group A of automorphisms of a free group F of rank 3 contains as a normal subgroup the group K of IA automorphisms--i.e., those automorphisms which induce the identity automorphism on the commutator quotient group F/F' of F. The K is generated by the nine automorphisms K sub 12, K sub 13, K sub 21, K sub 23, K sub 31, K sub 32, K sub 123, K sub 213, and K sub 312. The subgroup of automorphisms in K which leave the second and third generators of F fixed is shown to be generated by K sub 12, K sub 13, and K sub 123, and a set of defining relations for this group is found. The double indexed subgroup of K is shown to be the subgroup of automorphisms which take each generator of F into a conjugate of itself; a presentation for this group is given. The triple indexed subgroup is shown to be free. Several representations of K are also discussed, leading to some quotient groups of K. Considering the elements of K as ring automorphisms of the Magnus ring A(Z,3), it is shown that K is residually torsion-free nilpotent. Dissert. Abstr.

N70-19239# Bettis Atomic Power Lab., Pittsburgh, Pa.
APPROXIMATE J(THETA, BETA) FUNCTION (LWBR DEVELOPMENT PROGRAM)
N. M. Steen Aug. 1969 22 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-893) Avail: CFSTI

A fast and accurate method of approximating the J(theta,beta) function for a single resonance, a rapid method of averaging unresolved resonance levels by use of this approximate J function, and a recently developed quadrature scheme of the Gaussian type are described. The approximate J function was tested on that portion of the theta, beta plane for which beta > or = 5.0 × 10 to the minus 5th power and theta > or = 5.0 × 10 to the minus 4th power. On this domain typical relative errors incurred in J(theta,beta) are 0.25 percent or less, and the maximum relative error for any (theta,beta) pair is 2.2 percent which is encountered at an extreme value of beta = 0.5 × 10 to the minus 4th power. The technique for J function averaging produces relative errors less than 0.10 percent for cases of practical interest. Author (NSA)

N70-19245 New Mexico Univ., Albuquerque.
RIGHT CONGRUENCES ON BAER SEMIGROUPS
Billy Joe Thorne (Ph.D. Thesis) 1968 79 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-9270

Any congruence compatible with S is determined by its kernel, the problem of characterising ideals which are kernels of congruences compatible with S is of interest. This is accomplished by looking at a certain class of residuated maps on I(L(S)), the lattice of ideals of L(S). Of particular interest are the principal ideals of L(S). The principal ideal (O), Se) is the kernel of a congruence compatible with S if e is a central idempotent in S. The lattice of congruences compatible with S, is a subcomplete sublattice. Dissert. Abstr.

N70-19246 Wisconsin Univ., Madison.
NEW PROPERTIES AND SYNTHESIS OF CUT SET AND CIRCUIT MATRICES
Reza Hashemian (Ph.D. Thesis) 1968 205 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 68-17900

Determination of some topological properties of graphs, and the synthesis of cut-set, f-circuit, admittance and impedance matrices of n-port networks are discussed. The n-port network considered is a connected graph with n pairs of accessible terminals, and each edge of the graph consists of a one-port whose driving point impedance is a positive function. Properties of both Oriented and H-matrices are investigated and procedures to facilitate testing of Oriented and H-matrices are presented. It is shown that a Q-matrix can have any sign pattern provided that it is symmetric and the diagonal entries are positive. It is also shown that Q-decomposition is unique within interchanging rows or columns and multiplying some rows and columns by -1. The relationship between the rows of cut set and circuit matrices and topological form of cut sets and circuits of a network is used to establish the synthesis procedures. Dissert. Abstr.

N70-19248 New Mexico Univ., Albuquerque.
A SYNTHESIS PROCEDURE FOR THE RC CASE OF BASHKOW'S A MATRIX
James Eldon Steelman (Ph.D. Thesis) 1968 141 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-9266

A sufficient procedure is developed for the realization of Bashkow's matrix for the RC case. The realization procedure for an (n × n) A matrix requires that this A matrix be realizable based on an RC network with (n+1) nodes with an RC parallel pair connecting each node to every other node. The procedure is necessary and sufficient for n = 2, but an example is presented which demonstrates it to be not necessary for n greater or equal to 3. Computer calculations for a (3 × 3) example require about five minutes of IBM 360/40 time. The results for three different examples are shown and discussed. A sufficient procedure for realizing N-port conductance and resistance matrices is developed using portions of this realization procedure. Dissert. Abstr.

N70-19284 Virginia Polytechnic Inst., Blacksburg.
TESTING HYPOTHESES INVOLVING CATEGORICAL DATA
Gary Boyd Beus (Ph.D. Thesis) 1969 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-9924

Classical tests for goodness-of-fit and classical tests for independence in two-way contingency tables are well known and widely performed on categorical data. The problem as treated here arises when a number of such tests are to be performed at once. In performing a number of such tests, the classical procedure has been to perform marginal chi-square tests each at some specified level of significance. However, when several tests are performed at once to the same data, the chance that at least one of them will be significant is greater, and sometimes much greater, than the presumed probability. Exact simultaneous test procedures which accommodate tests for goodness-of-fit or tests for independence in contingency tables are developed in the case of independently distributed test statistics. Upper percentage points of the chi-square distribution are provided in a form convenient for the performance of these simultaneous tests. Dissert. Abstr.

N70-19284 New Mexico Univ., Albuquerque.
FORMALLY REAL FIELDS
Gail Lee Carns (Ph.D. Thesis) 1968 43 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-9238

The analysis of the set of orders on a formally real field using category and sheaf theory as tools is discussed. The set of orders similar to that used in the prime spectrum of algebraic geometry are topologized and are defined as presheaf of groups using the notion of inverse limits. With the associated sheaves there exists a sheaf homomorphism from g to the direct image of g' under psi. This produces a contravariant functor A from the category of fields with inclusions to the category of ringed spaces and ringed space morphisms. Dissert. Abstr.

N70-19297 Texas A&M Univ., College Station.
EMBEDDING OF NEAR-RINGS
Henry Edward Heatherly (Ph.D. Thesis) 1968 60 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-8480

An elementary proof shows that every near-ring can be embedded in a near-ring with identity and in fact in T(G), the near-ring of all transformations on some group G. The question of embedding a distributively generated near-ring in a near-ring generated by endomorphisms on some group is considered. This is shown to be equivalent to the question of embedding a distributively generated near-ring in a distributively generated near-ring with identity. Although distributive near-rings are an equationally defined class it is shown that distributively generated near-rings are not. The effect of having no divisors of zero on finite near-rings is discussed. It is shown that a finite near-ring which contains an element which is not a left divisor of zero must have a left identity. Also a finite distributive near-ring which contains an element which is not a zero divisor must be a ring. Dissert. Abstr.

N70-19299 Georgia Univ., Athens.
CONCERNING VECTOR SEMIGROUPS
Thomas Hubbard Mc Hatton Hanson (Ph.D. Thesis) 1968 80 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 69-9488

Conditions under which topological semigroups can be split

by vector semigroups are determined. Criteria are given for the action of a Lie group on a locally compact space leading to a fiber bundle. Several theorems are proven for vector semigroups. Dissert. Abstr.

N70-19301 Wisconsin Univ., Madison.
IDEAL THEORY IN NON-NOETHERIAN RINGS
Douglas Haines Underwood (Ph.D. Thesis) 1968 77 p
Avail: Univ. Microfilms: HC $4.20/Microfilm $3.00 Order No. 68-16028

Let R be a commutative ring with identity. If the ideal A of R has a representation as a finite irredundant intersection of primary ideals, as is always true in a noetherian ring, then the several properties hold. Dissert. Abstr.

N70-19345# Wisconsin Univ., Madison. Mathematics Research Center.
BRANCHING OF SOLUTIONS OF AN EQUATION IN HILBERT SPACE
D. Sather May 1969 36 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-696326; MRC-TSR-982) Avail: CFSTI CSCL 12/1

A constructive method is developed to study the branching of solutions of the equation (I - lambda L)w + T(w) = nu p in a (real) Hilbert space H(lambda and nu are real parameters). The operator L is linear selfadjoint and compact, and the nonlinear operator T maps a neighborhood of the origin in H into H and is homogeneous of (integral) degree k(k = or > 2). The approach is based on the Lyapunov-Schmidt method and does not require that the nonlinear operator T be compact. Author (TAB)

N70-19350*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
A METHOD OF MAPPING FOR SOLVING EXTREMUM PROBLEMS WITH CONSTRAINTS [METOD OTOBRAZHENIY DLYA RESHENIYA EKSTREMALNYKH ZADACH S OGRANICHENIYAMI]
E. Rayk et al Washington NASA Feb. 1970 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk Estonskoi SSR (Tallin), v. 17, no. 3, 1968 p 255-259
(Contract NASw-1692)
(NASA-TT-F-12805) Avail: CFSTI CSCL 12A

A general method to reduce an extremum problem with constraints to a problem without constraints is proposed. For this method a mapping phi (y) is neeede which maps a Banach space Y on a set that is everywhere dense in the constraint set. The method is comparable to the method of penal functions except that it deals with only one problem for the unconditional minimum. Formulation for the problem without constraints is presented. Author

N70-19385 Wisconsin Univ., Madison.
INVESTIGATIONS ON THE INTUITIONISTIC PROPOSITIONAL CALCULUS
Dick Herman Jacobus de Jongh (Ph.D. Thesis) 1968 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-894

A summary of the results previously reached in the field of semantics of intuitionistic logic is presented. The concept of connective for intuitionistic logic with respect to the I-valuations is discussed. Connectives are represented by certain functions called I-operators, and a functional completeness is attempted of the usual connectives with respect to some restricted classes of I-operators. An extension of the concepts to I-valuations with infinite domains is studied and a functional completeness theorem for the usual connectives combined with infinite conjunction and disjunction is proved. A partial functional completeness theorem is applied to obtain a characterization of the intuitionistic propositional calculus. It is proved that, if a propositional calculus contains the axion schemata of the intuitionistic propositional calculus and maybe some other axiom schemata and fulfills certain given properties, then all formulas provable in that propositional calculus are provable in the intuitionistic propositional calculus. Dissert. Abstr.

N70-19386 Georgia Univ., Athens.
EMBEDDING POLYHEDRA IN EUCLIDEAN SPACE
Kreso Horvatic (Ph.D. Thesis) 1968 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9494

The theory of embedding in the piecewise linear (PL) category is discussed with the necessary definitions of the objects dealt with, and some basic theorems in PL theory. A brief description of the Wu-Shapiro invariant is given. The main theorem; that, for there to exist an embedding of the n-polyhedron X into 2n-space, it suffices that the integral cohomology group H to the nth power (X-Int A) = 0 for some n-simplex A of a triangulation of X is proved. The known embedding results are examined for PL manifolds over a large class containing various kinds of generalized manifold, such as triangulated manifolds, polyhedral homology manifolds, pseudomanifolds, and manifolds with singular boundary. A polyhedron X strongly embeds into Euclidean k-space E(k) if any embedding of any subpolyhedron of X into E(k) can be extended to an embedding of X into E to the kth power it is observed that every n-polyhedron strongly embeds in E to the kth power if k > or = to 2n + 1. and no such polyhedron strongly embeds into E to the kth power, k < or = to 2n - 1. It is proved that every polyhedral homology n-manifold with non-empty boundary (in particular every PL manifold with boundary) embeds into (2n-1)-space. Dissert. Abstr.

N70-19464 Rutgers Univ., New Brunswick, N.J.
OPTIMIZATION OF MULTIVARIABLE DISTRIBUTED PARAMETER SYSTEMS
Victor J. Tarassov (Ph.D. Thesis) 1968 253 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.30 Order No. 69-7590

The processes studied involve multiple dependent variables which are functions of both the temporal and spatial independent variables. The optimization is developed for a general integral type of cost functional with weighted energy constraints. Three specific classes of control are considered; distributed space and time control, distributed time control, and distributed space control. The admissible system dynamics is restricted to be of the coupled quasi-linear first order partial differential equation type. This method of analysis is particularly useful for systems of partial differential equations with the same principal part. Under these conditions the actual number of integrations is reduced when the integrations are performed along the characteristic directions. This type of problem is frequently encountered in process control applications dealing with plug flow tubular reactors. The theory is then applied to the optimal control of dissolved oxygen in a stream. Dissert. Abstr.

N70-19466 Catholic Univ. of America, Washington, D.C.
NOETHERIAN DECOMPOSITIONS IN A RESIDUATED LATTICE WITH AN ASSOCIATIVE MULTIPLICATION
Catherine Mary Murphy (Ph.D. Thesis) 1968 84 p
Avail: Univ. Microfilms: HC $4.40/Microfilm $3.00 Order No. 69-9173

A theory of Noetherian decompositions in the residuated lattice R which satisfies certain axioms was developed. The motivating model for this structure is the set of left ideals in a ring with the usual operations of ideal multiplication, intersection, and sum. However, there are examples of R which are not isomorphic to any sublattice of the lattice of left ideals of a ring. Three types of decompositions are discussed-primal, tertiary and primary. Of these only the primal always exists. Sufficient conditions for the existence of the tertiary are given. Three radicals are defined-primal, tertiary, and primary-and their relationships to the primal, tertiary, and

primary decompositions, respectively, are found. Necessary and sufficient conditions for the three radicals to coincide are presented. The dissertation concludes with the development of the theory of Noetherian decompositions relative to the lattice ideals R(v) = (x in R / x is less than or equal to v) of R. Dissert. Abstr.

N70-19485*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
THE VARIATIONAL METHOD 2: PERTURBATION THEORY
Saul T. Epstein 10 Mar. 1969 60 p refs
(Grant NGL-50-002-001)
(NASA-CR-108087; WIS-TCI-338) Avail: CFSTI CSCL 12A

The use of the variational method of approximate solutions of the perturbation equations, and the perturbation analysis of optimal trial functions and energies are discussed. The connection which goes from the perturbation theory to a variational principle is also considered. The Hylleraas variational method and its applications are emphasized, and the Delves variational approach is described. N.E.N.

N70-19486*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
VARIATIONAL METHOD 3: STEADY STATE TIME DEPENDENT PERTURBATION THEORY
Saul T. Epstein 18 Mar. 1969 69 p refs
(Grant NGL-50-002-001)
(NASA-CR-101684; WIS-TCI-339) Avail: CFSTI CSCL 12A

The response of a system (atom or molecule) to a time dependent external field is discussed, and the Schroedinger equation with the time independent internal Hamiltonian of the isolated system and electric field effects is solved. Particular interest is given to the situations in which the effect of the external field is a simple harmonic in time with the frequency, and the initial conditions include the normalized ground state wave function for the Hamiltonian. Variational methods are discussed, and sum rules, double perturbation theory, theorems satisfied by optimal trial functions, and imaginary frequencies are also considered. N.E.N.

N70-19497# European Organization for Nuclear Research, Geneva (Switzerland).
SOME QUESTIONS CONCERNING ADIABATIC TRANSFORMATIONS
G. C. Wick (Columbia Univ.) 15 Jul. 1969 11 p refs
(NYO-1932(2)-157) Avail: CFSTI

Some results for the adiabatic theorem in quantum field theory are clarified and simplified. When a coupling constant is switched on exponentially, the adiabatic limit is obtained. For finite alpha the state attained by the system at the time t = 0 satisfies a well-known differential equation with respect to the coupling constant g. This equation was previously obtained by means of a perturbation expansion in the interaction representation. It is pointed out that a much simpler derivation can be given without using a perturbation expansion. The limit alpha approaches limit of 0 is mainly discussed. It is shown that this limit can be checked for an arbitrary order n by using the differential equations in g satisfied by the previously given state vectors. The relation between the adiabatic solution and the Rayleigh–Schrodinger perturbation series is thus completely established. NSA

N70-19498# Institute of Nuclear Research, Warsaw (Poland).
NUMERICAL SOLUTION OF A NONLINEAR PARABOLIC EQUATION
R. J. Bednarz and D. Makosa 1969 20 p refs
(INR-1099) Avail: CFSTI

A difference scheme is developed for the solution of a nonlinear parabolic equation. The truncation error for the difference approximation to the equation and boundary conditions is of the second order. An initial-boundary-value problem related to quasi-linear theory of plasma oscillations is solved, using a program applying the scheme. Author (NSA)

N70-19502 Wisconsin Univ., Madison.
STUDIES IN THE MODELING OF STOCHASTIC AND DYNAMIC SYSTEMS WITH SPECIAL REFERENCE TO THE DISTRIBUTION OF RESIDUAL CORRELATIONS
David Alan Pierce (Ph.D. Thesis) 1968 238 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.00 Order No. 69-17929

An approach to the modeling of stationary and nonstationary time series such as commonly occur in economic situations and control problems, involves iterative use of the three-stage procedure of identification, estimation, and diagnostic checking. In the present study methods of identification are developed for a class of models and procedures of parameter estimation and properties of parameter estimates are examined. The main emphasis, however, is on the third stage of diagnostic checking, which includes both tests of fit of the models and means of indicating any needed model modifications. An important technique in diagnostic checking is the study of the residuals calculated from the parameter estimates after fitting the model; and on the assumption that the residuals from a correctly fitted model should exhibit approximately the same behavior as white noise and thus be nearly uncorrelated, it would be expected that useful indicators of model inadequacy can be provided by the residual autocorrelations. Dissert. Abstr.

N70-19539# Los Alamos Scientific Lab., N. Mex.
METHOD OF DESCENT FOR FINDING THE ROOTS OF POLYNOMIALS IN A SINGLE VARIABLE
Zane C. Motteler 23 Jul. 1969 40 p refs
(Contract W-7405-eng-36)
(LA-4222) Avail: CFSTI

A method for finding the roots of a polynomial and a subroutine for the CDC 6600 embodying the method are described. The algorithm is based upon determining a direction of descent from a given point by examining the first nonzero derivative at that point; rather involved calculations then provide a distance to move in this direction. If the first derivative is nonzero then this method is a modified version of Newton's method. Author (NSA)

N70-19545# Los Alamos Scientific Lab., N.Mex.
CANTOR-TYPE INTERVAL DISSECTIONS AS RANDOM NUMBER TESTS
W. A. Beyer Sep. 1969 6 p refs
(Contract W-7405-eng-36)
(LA-4266) Avail: CFSTI

Discussion is given of a class of random number tests, in the sense of Kolmogorov's and Martin-Löf's new theory of the von Mises 'collective,' the members of which are generalizations of Cantor's 'middle third' dissection of the unit interval. In the case of Bernoulli trials with success probability p > or = to 1/2, p computable, it is shown that the Hausdorff dimension of the set of nonrandom numbers is not less than -log 2/log (1-p). Author (NSA)

N70-19562# Oak Ridge National Lab., Tenn.
PROPERTIES OF THE SPECTRAL RADIUS OF THE INTEGRAL TRANSPORT OPERATOR IN SLAB GEOMETRY
Paul Nelson, Jr. Nov. 1969 23 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2740) Avail: CFSTI

The governing equation for transport in slab geometry is written for the angular flux, the source function, and the maximum expected number of secondaries emitted per collision. Physical reasoning dictates that the spectral radius of the positive linear integral operator should be an eigenvalue. These results are established under minimal assumptions on the data defining the slab material properties. Author (NSA)

N70-19606 Purdue Univ., Lafayette, Ind.
PRODUCTS OF FUNCTION ALGEBRAS
Larry Quin Eifler (Ph.D. Thesis) 1968 50 p

Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 69-7438

A classical result of W. F. Osgood states that if f is a continuous function on the open unit bicylinder and if f is analytic in each variable separately then f is analytic in two variables. This motivates too natural ways of forming products of function algebras. Let A be a function algebra on X and let B be a function algebra on Y. The slice product of A and B and the tensor product of A and B are proved to be equal within certain limits. Dissert. Abstr.

N70-19678 Rutgers Univ., New Brunswick, N.J.
AN AXIOMATIC POTENTIAL THEORY IN UNIFORMLY CONVEX BANACH SPACES OF FUNCTIONS
Peter Alan Fowler (Ph.D. Thesis)
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-7536

Notations and definitions are given for a locally compact Hausdorff space and a Banach-Dirichlet space of equivalence classes of scalar valued functions which are locally integrable with respect to a Radon measure verifying three Dirichlet axioms. Limiting factors are given for the existence of potential elements of positive dual cones. Eight theorems are also given that extend to Banach-Dirichlet space. Dissert. Abstr.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N70-18322 National Lending Library for Science and Technology, Boston Spa (England).
A METHOD OF ASSESSING THE QUALITY OF AIR FIELD WEATHER FORECASTS (TAF), TAF VERIFICATION
W. von Bezold 25 Sep. 1969 13 p ref Transl. into ENGLISH from Met. Rund. (Heidelberg), no. 22, 1969 p 43-46
(NLL-M-7800-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Eng.: .1 NLL photocopy coupons

The results are given of analysis of a simple graphical method of plotting the discrepancy between the weather conditions forecast for an air field in a standard TAF report, and those actually materializing. It is concluded that the method forms a useful yardstick and should be of educational benefit to novices and those unacquainted with local conditions. Author

N70-18366# Fleet Numerical Weather Central, Monterey, Calif.
EXTENDED RANGE ANALOG FORECAST PROGRAM AT FLEET NUMERICAL WEATHER CENTRAL
Paul M. Wolff and Carl D. Thormeyer Sep. 1969 36 p refs
(AD-696538; TN-49) Avail: CFSTI CSCL 4/2

The Fleet Numerical Weather Central Analog Forecast Program uses a digitized data bank of 500 mb, surface and zonal wind data for the period 1946-1969. The program searches the data bank for data fields within 30 days of the forecast date and a screening process ultimately selects the best hemispheric analog. The screening technique employs correlation in space and time of 500 mb and 1000 mb large and small scale components together with indices of the zonal wind profile. The analog forecast has been computed operationally twice a week since 1 March 1969. The analog forecasts are transmitted via high-speed data links to Fleet Weather Centrals in Guam; Pearl Harbor; Norfolk, Virginia and Rota, Spain. Author (TAB)

N70-18400# Miami Univ., Fla.
ROSENSTIEL SCHOOL OF MARINE AND ATMOSPHERIC SCIENCES. RADAR HURRICANE RESEARCH Final Report, 1 Sep. 1968-31 Aug. 1969
Harry V. Senn and Charles L. Courtright Nov. 1969 35 p refs
(Contract ESSA-E-22-69-(N))
(ML-70005) Avail: Issuing Activity

A three-dimensional, quantitative study of the eye wall features in hurricanes Cleo, Betsy, and Inez was made. While the maximum heights reached were over 18.5 km in one storm and averaged about 10 km for the times studied, the mean height of all eye wall echoes was 8 km. Echoes with the largest areas of most intense precipitation were higher than those with smaller areas of equal intensity. The areas of several discrete precipitation intensities calculated from a radar-rainfall Z-R relation peculiar to the South Florida region, were correlated with echo heights as well as other hurricane features. An attempt was made to determine whether a unique brightest radar echo area of greater-than-normal intensity exists in several storms, and if so, whether it has any definite relationship to other larger scale hurricane features. Author

N70-18496 National Lending Library for Science and Technology, Boston Spa (England).
CERTAIN PROBLEMS OF THE NUMERICAL INTERPRETATION OF CLOUD INFORMATION RECEIVED FROM ARTIFICIAL EARTH SATELLITES
S. A. Musaeljan 25 Sep. 1969 19 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 166, 1964 p 203-213
(NLL-M-7801-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

Fourier coefficients of the m-th order for the fields of cloudiness and vertical currents respectively are presented. The constants were calculated by the method of least squares from actual observational data for July 1962. Calculations showed that these coefficients could be used for other months in the warm half of the year in addition to July. In any case, calculations of vertical currents from the cloudiness field for June and August 1962 and for May 1960 gave quite satisfactory results. Analysis of a large number of cloudiness charts showed that large-scale cloudiness fields have a certain persistence and change only slightly from day to day, although cloud may change substantially over short intervals at certain points. Since analysed vertical currents can be calculated by the above method, the question of their use arises. As an application of the method described above we consider the problem of determining the geopotential field from the distribution of cloudiness. Author

N70-18582*# Weather Bureau, Suitland, Md. Upper Air Branch.
SOME PROPERTIES OF DATA FROM FALLING SPHERE SOUNDINGS
R. S. Quiroz *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 227-256 refs (See N70-18570 07-01)
Avail: CFSTI CSCL 04B

Proper use of reduced data from falling sphere soundings requires a detailed knowledge of the many factors affecting their accuracy. Criteria for judging the reliability of ROBIN sphere data (wind and density) are reviewed, and the effect of the data smoothing interval on the suppression of radar tracking error and the retention of real atmospheric detail is briefly considered. The height range of valid temperatures is described in relation to the prevailing pressure scale height and the climatological temperature regime. ROBIN soundings considered valid by stated criteria are presented which illustrate their fidelity to large-scale atmospheric variations. Special data comparisons include Arcasonde and ROBIN temperatures from Ascension Island, which indicate fair agreement near the stratopause; and densities based on thermistor and sphere data. The latter reveal a systematic difference of about 8%; various explanations are considered, but none is found to account for the full difference. Author

N70-18677# Army Foreign Science and Technology Center, Washington, D.C.
EXPERIMENTAL USE OF RADIO INFORMATION FROM

SATELLITES IN OPERATIONAL WORK
P. N. Belov et al. 3 Nov. 1969 16 p refs Transl. into ENGLISH from Gydrneteorol. Nauchno Issledovatel'Skiy Tsentr SSSR Tr. (USSR), no. 26, 1968 p 54-60
(AD-697325; FSTC-HT-23-014-70) Avail: CFSTI CSCL 4/2

The meteorological data provided by the Cosmos satellites are said to have produced new information on the state of the Earth and atmosphere, and on outgoing longwave and shortwave radiation. The synoptic interpretation of the outgoing radiation charts has made it possible to determine the position of the atmospheric fronts, intertropical convergence zones and other meteorological phenomena. Two types of radiation temperature distribution have been defined which will be helpful in pinpointing the possible regions in which typhoons and hurricanes originate. The use of the actinometric data obtained through the satellites has made it possible to establish the position of the major fronts above the eastern Pacific Ocean, which was previously impossible, and even to define the wave-forming regions. Author (TAB)

N70-18725# Defense Documentation Center, Alexandria, Va.
WEATHER SATELLITES, VOLUME 1 Bibliography Report, Jan. 1958-May 1968
Oct. 1969 92 p refs
(AD-696901; DDC-TAS-69-63-1) Avail: CFSTI CSCL 22/2

Capabilities and potentialities of weather satellites to detect meteorological parameters such as rain, temperature, cloud cover, and wind for weather-forecasting purposes are examined. Various types of equipment for meteorological uses and data-handling are evaluated and some improved procedures are considered. Photographic data on tropical cyclones (hurricanes and typhoons) derived principally from TIROS satellites comprise and important subject of research. Author (TAB)

N70-18764*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE DETERMINATION OF ATMOSPHERIC TEMPERATURE PROFILES FROM PLANETARY LIMB RADIANCE PROFILES
James W. Burns and William G. Uplinger Washington NASA Feb. 1970 93 p refs
(Contract NAS1-8048)
(NASA-CR-1513) Avail: CFSTI CSCL 04A

A study was conducted to demonstrate the feasibility of inverting planetary limb radiance to infer atmospheric temperature structure. The method is based on the existence of a closed form solution to the equation of radiative transfer for a nonisothermal atmosphere specifically linear temperature gradients. Feasibility has been demonstrated by deriving a convergence theorem and stability criteria and by numerically inverting limb radiance data for various climatological models and experimental data. Inversion results over the altitude range of 30 to 60 km were generally accurate to less than + or − 2 K in the stratosphere with peak errors of approximately + or − 3 K. Inversion results for the mesophere indicate that accuracies comparable or better than MRN data are possible. Author

N70-18798# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
CLIMATOLOGY OF THE COLD REGIONS NORTHERN HEMISPHERE 2
C. Wilson Aug. 1969 179 p refs *Its* Cold Reg. Sci. and Eng. Monograph No. 1, Sect. A3B
(AD-697139; CRREL-CRSE-1-A3B) Avail: CFSTI CSCL 4/2

The review summary of the climatological environment of the northern cold regions begun in CRSE Monograph I-A3a (AD-656 447) concludes with the three sections on Temperature (including inversions), Humidity and Precipitation, and Winds. Each section has a selected but extensive bibliography. Author (TAB)

N70-18806 National Lending Library for Science and Technology, Boston Spa (England).
SOME POSSIBLE WAYS OF DETERMINING THE DANGER OF MUD FLOWS IN THE BASINS OF RIVERS ON THE NORTHERN SLOPES OF THE ZAILIJSKIJ ALATAU
R. S. Golubov et al [1969] 16 p refs Transl. into ENGLISH from Tr. Kazakhsk. Nauchn.-Issled Gidrometeorol. Inst. (Leningrad), v. 29, 1967 p 42-48
(NLL-M-7753-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The meteorological parameters which might be used in estimating the danger of mud flows in regions of the Zailijskij Alatau are analyzed. Criteria for mud flows of shower and glacier origin are considered. Author

N70-18812# Army Foreign Science and Technology Center, Washington, D.C.
PRACTICAL EXPERIMENTS WITH A MIXTURE OF SODIUM CHLORIDE AND CEMENT AS A REAGENT FOR SEEDING LARGE CUMULUS CLOUDS
E. P. Budilova et al 3 Nov. 1969 15 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 224, 1968 p 23-36
(AD-697324; FSTC-HT-23-008-7021) Avail: CFSTI CSCL 4/2

The paper reviews the results of artificial rain-making by seeding convective clouds with a mixture of sodium chloride and cement. Light to moderate artificial rain, lasting from 15-30 minutes to an hour, was produced in 57% of the cloud-seeding cases involving the use of a hygroscopic reagent. The best results were achieved by the use of 4 kg to 1 kg of the reagent per 1 km of cloud area. The area covered by the artificial rain was 1-5 kilometers but more often 2-3 kilometers. The maximum possible quantity of artificial precipitation did not exceed 5% of the average monthly natural rainfall. In most cases a positive seeding effect was achieved with clouds whose vertical thickness exceeded 2.4 kilometers. Author (TAB)

N70-18834# Wisconsin Univ., Madison. Dept. of Meteorology.
STUDIES OF EFFECTS OF BOUNDARY MODIFICATION IN PROBLEMS OF SMALL AREA METEOROLOGY Annual Report (Final), 1967-1968
Heinz H. Lettau and Charles R. Stearns Apr. 1969 190 p refs
(Contract DA-AMC-28-043-66-624)
(AD-697186; ECOM-66-G24-F; AR-2) Avail: CFSTI CSCL 4/2

Contents: Evapotranspiration climatonomy; Estimates of vorticity, divergence, and vertical velocity in a surface layer; Thermal response of a plant canopy to drifting cloud shadows; Thermal response of a concrete slab to controlled daytime and nighttime cycles of radiation; Topographic influence on tornado tracks and frequencies in Wisconsin and Arkansas; The theory of variangular wind spirals; The determination of the surface roughness from wind speed and air temperature profiles in the surface layer; Thermo-tidal winds in an equivalent barotropic boundary layer; Note on aerodynamic roughness-parameter estimation on the basis of roughness-element description; The surface heat budget of the Pampa de La Joya, Peru. TAB

N70-18859 Cornell Univ., Ithaca, N.Y.
A STOCHASTIC APPROACH TO THE STUDY OF EVAPORATION FROM LAKE ONTARIO
Shaw-Lei Yu (Ph.D. Thesis) 1968 161 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-7409

Monthly mean values of evaporation from Lake Ontario were studied as a time series for the period 1872 to 1965 inclusive. The evaporation estimates were generated by a mass-transfer equation. The mass-transfer coefficient was calculated using Harbeck's equation, relating the coefficient with water surface area. In order to obtain long-term values of water surface temperature for Lake Ontario, an estimation equation was developed, based on statistical analyses of the relationship between observed water temperature, air temperature, wind speed, and sunshine percentage

records. A first order Markov model was found to adequately describe the evaporation, air temperature, and relative humidity anomalies, whereas a second order model could be used to fit the anomalies of wind speed and the water surface temperature. Dissert. Abstr.

N70-18866*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
INVESTIGATION OF WARM FOG PROPERTIES AND FOG MODIFICATION CONCEPTS Annual Summary Report
Warren C. Kocmond and William J. Eadie 31 Dec. 1969 70 p refs
(Contract NASr-156)
(NASA-CR-108130; CAL-RM-1788-P-22; ASR-5) Avail: CFSTI CSCL 04B

Field experiments were performed to determine the effects of seeding natural valley fog with carefully sized hygroscopic materials. Airborne seedings were found to be most effective in causing fog dissipation. In one experiment, 700 lbs of carefully sized NaCl particles were disseminated onto the fog top from a light aircraft. Visibility in the seeded area increased from 300 feet to 2600 feet within 15 minutes after seeding. Analysis of data showed that improvement in visibility resulted from a favorable shift in the fog drop-size distribution and a decrease in the liquid water content of the fog as a result of precipitation of the large droplets formed on the seeding nuclei. A computer model was developed to simulate warm fog seeding experiments. The effects of several variables on fog modification were studied. The influence of particle size distribution, seeding rate, and horizontal diffusion were investigated with the model and are discussed. Laboratory tests of various hygroscopic seeding agents performed in a 600 cu m cloud chamber show that NaCl, urea, certain phosphates and a 9:1 solution of ammonium nitrate/urea/water are effective in promoting fog dissipation. Author

N70-18987 National Lending Library for Science and Technology, Boston Spa (England).
AN ANALYSIS OF THE SUCCESS OF WEATHER FORECASTS IN ESTIMATING THE DANGER OF MUD-FLOWS
V. R. Ryndina 25 Sep. 1969 10 p refs Transl. into ENGLISH from Tr. Kazakhsk. Nauchn.-Issled. Gidrometeorol. Inst. (Leningrad), v. 29, 1967 p 55-58
(NLL-M-7787-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

Weather forecasts, particularly the precipitation forecasts by the Bajdal and Golubov methods for providing mud-flow warnings in the regions of Zailijskij Alatsu are analyzed. In the Golubov method the amount was given in four ranges: less than 10, 10 to 20, 20 to 30, and greater than 30 mm. For the Golubov method, the results indicate the occurrence of rain forecast were correct 88% of the cases, and 76% for the Bajdal method. It is concluded that for mud-flow warnings, the beginning of precipitation, amount, duration, and variation with height must be forecasted more accurately than possible by the existing systems. F.O.S.

N70-19014 California Univ., Davis.
ICE AGE THEORY ANALYSIS BY COMPUTER MODEL SIMULATION
Michael Calvin Mac Cracken (Ph.D. Thesis) 1968 202 p
Avail: Univ. Microfilms: HC $9.25 / Microfilm $3.00 Order No. 69-8969

A numerical computer model of the earth-atmosphere system is used in a quantitative evaluation of several of the currently popular ice age theories. The model is based upon the primitive hydrodynamic and thermodynamic equations in a complete flux divergence form. The equations are reduced to two dimensions by assuming the longitudinal derivatives to be zero. This is done in order to increase the model computing time to real time ratio to a practical level. This zonal structuring eleminates the possibility of diffusion processes. Instead of modeling meteorological phenomena, therefore, the longitudinally averaged climate is represented. The model then investigates the stability of the climatic patterns postulated by the ice age theory under consideration. Dissert. Abstr.

N70-19261# Sandia Corp., Albuquerque, N. Mex.
SELECTED CLOUD CHARACTERISTICS FOR WALLOPS ISLAND, VIRGINIA
H. W. Church Nov. 1969 23 p refs
(SC-RR-69-734) Avail: CFSTI

Ten years of weather station surface cloud observations are analyzed in order to obtain a climatological description of occurrences of middle layer stratus type clouds for Wallops Island Missile Range. It is shown that altostratus or nimbostratus clouds were reported about 5 percent of the time in winter, decreasing to 2 percent in summer, while overcast sky was reported 43 percent of the time in February, decreasing to 23 percent in July. Author (NSA)

N70-19365# Hawaii Inst. of Geophysics, Honolulu.
HAWAIIAN WEATHER FORECAST STUDIES Final Report
C. S. Ramage Jan. 1970 12 p refs
(Contract ESSA-E-106-69(N)); Grant NSF GH-28)
(HIG-69-24) Avail: Issuing Activity

The available ocean-wave and surface-wind data from the Hawaiian area are investigated in order to provide a statistical climatology of wave conditions and to study available techniques for wave-height prediction in this area. Prognostic regression equations for ocean-wave height at two locations are derived by a multiple regression technique. A simple linearized system in an adiabatic atmosphere, where potential temperature is constant, is used to investigate the initial value problem in the tropics. In the linear system it is possible to assign an exact definition of initial divergence and vorticity such that only Rossby waves are present initially, and gravity waves are completely eliminated. An attempt is made to determine the interrelationships among some meteorological variables by a lag-correlation technique. Emphasis is on the relationship of Hawaiian summer rainfall to the local variation of surface wind speed, surface pressure, and 250 mb height. The feasibility of predicting rainfall from daily satellite cloud data over a section of the eastern north Pacific is explored. R.B.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N70-18558# Naval Research Lab., Washington, D.C. Communications Sciences Div.
LANE COUNTER FOR THE TRACOR 599R OMEGA RECEIVER
W. D. Meyers Sep. 1969 11 p
(AD-696529; NRL-MR-2036) Avail: CFSTI CSCL 17/7

Omega is a long range, very-low-frequency hyperbolic radio navigation system for use by aircraft, ships and submarines. Coverage for the entire earth will be provided by eight transmitters operating at the base frequency of 10.2 kilohertz. One of the characteristics of the system is that phase information representing a hyperbolic line-of-position repeats itself each half cycle of the base frequency. Thus, the navigator must know the exact cycle or lane in which he is located. Ideally, the Omega receiver would automatically count lane crossings and present the lane number on a suitable display. This report describes a modification for the Tracor 599R Omega receiver that adds this lane counting feature. Author (TAB)

N70-18762*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LAUNCH VEHICLE ERROR SENSITIVITY STUDY
Richard C. Rosenbaum and Robert E. Willwerth Washington NASA Feb. 1970 48 p refs
(Contract NAS1-8920)
(NASA-CR-1512) Avail: CFSTI CSCL 22C

A method is presented for shaping a booster trajectory to minimize the sensitivity of terminal constraints to variations in vehicle or atmosphere parameters. An example, using the Scout booster, is given in which it is shown that the sensitivity of terminal altitude to variations in first stage burn rate can be reduced by 50%. An investigation, using trial and error techniques, is also made to examine the influence of the trajectory shape on some of the other major error sources for the Scout vehicle. Author

N70-19113# Army Electronics Command, Fort Monmouth, N.J. Avionics Lab.
HELICOPTER FLIGHT TEST OF DIFFERENTIAL OMEGA
Irving Levine Sep. 1969 35 p
(AD-697128; ECOM-3188) Avail: CFSTI CSCL 17/7

The present position-determining capability of a Differential OMEGA System when operating in a localized area was investigated. A system consisting of a ground monitor OMEGA receiver station and an airborne OMEGA navigation system (installed in a UH-1M helicopter) was used for the tests. Results indicate an order of magnitude improvement with differential OMEGA over the performance obtained with uncorrected OMEGA. Author (TAB)

N70-19186*# Techtran Corp., Glen Burnie, Md.
SYNTHESIS OF AUTOMATIC FLIGHT CONTROL SYSTEMS USING OPTIMAL CONTROL THEORY
Kenji Nakagawa et al Washington NASA Feb. 1970 20 p refs Transl. into ENGLISH from Japan Soc. for Aeron. and Space Sci., (Japanese) v. 16, Dec. 1968 p 425-434 Presented at the Japan Soc. for Aeron and Space Sci. 5 Apr. 1967 and at the Soc. Aircraft Symp., 16 Nov. 1967
(Contract NASw-1695)
(NASA-TT-F-12795) Avail: CFSTI CSCL 17G

This paper suggests a method for synthesizing linear flight control systems by applying optimal control theory associated with a quadratic performance index. Synthesis is done by quantitatively evaluating performance of transient response with the aid of digital and analog computers. Design procedure is illustrated for a conventional aircraft attitude-control system and for VTOL aircraft automatic stabilization equipment. Results obtained by the classical root-locus method, the root-square-locus method, and the proposed method are compared. It is shown that the proposed method makes excellent control system design possible. Author

N70-19317*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
SEQUENTIAL ESTIMATION OF STATES OF A BALLISTIC VEHICLE IN AN IMPERFECTLY KNOWN ATMOSPHERE
Antal K. Bejczy 15 Dec. 1969 49 p refs
(Contract NAS7-100)
(NASA-CR-108208; JPL-TR-32-1405) Avail: CFSTI CSCL 17G

The maximum principle least-squares nonlinear filter is applied for sequentially estimating the states of a ballistic vehicle in a partially unknown atmosphere, given noisy linear or nonlinear observations on all states. Methods for reducing the filter's dimensionality and mathematical complexity are developed. An ultimate simplification of the filter scheme is obtained. Tracking performance and reliability of the simplified filter schemes are tested by extensive digital simulation studies employing the continuous formulation of the filter. The simplified filters consistently exhibit better tracking performance than the full filter schemes. Typically, the simplified filters operate with a transient time of 0.5–2.0 s. The relative errors the simplified filters provide for the estimated states are approximately 10% or less of the relative errors in the measured states. Furthermore, the simplified filters provide reliable tracking even for 100% or more mismatch of the values of the atmospheric parameters. The ultimately simplified filter, which is a constant gain diagonal filter, can be mechanized by approximately 95% reduction of the mathematical operations needed to mechanize the full filter. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N70-18484# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Progress Report, Apr. – Jun. 1969
A. L. Bement, G. J. Dau, E. A. Evans, and R. E. Nightingale, eds. Aug. 1969 159 p refs
(Contract AT(45-1)-1830)
(BNWL-1144) Avail: CFSTI

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2. HTGR GRAPHITE: THE RADIOLYTIC REACTION OF GRAPHITE WITH WATER VAPOR R. E. Woodley p 4.1-4.2 refs (See N70-18486 07-06)

3. NUCLEAR CERAMICS: PROPERTIES OF MOLTEN FAST REACTOR OXIDE FUELS R. P. Nelson, J. J. Rasmussen, O. D. Slagle, and R. E. Nightingale p 5.1-5.40 refs (See N70-18487 07-22)

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6. IRRADIATION DAMAGE TO REACTOR METALS: REACTOR METALS RESEARCH L. D. Blackburn p 12.1-12.75 refs (See N70-18490 07-22)

N70-18485# Battelle-Northwest, Richland, Wash.
NUCLEAR GRAPHITE: INERT-GAS-SENSITIZED RADIOLYSIS STUDIES
R. E. Nightingale and G. L. Tingey *In its* Reactor Fuels and Mater. Develop. Programs for Fuels and Mater. Branch of USAEC Div. of Reactor Develop. and Technol. Aug. 1969 p 3.1–3.3 refs (See N70-18484 07-22)
Avail: CFSTI

The 100-eV yield of the radiolytic reaction of CO2 and H2 in a helium carrier decreases with CO2 and H2 concentration below 3500 ppM. At 350 C the G(CO) for the mixture is 1.9 molecules/100 eV at concentrations of CO2 and H2 above 3500 ppM. At H2 and CO2 concentrations of 300 ppM, the G(CO) is 1.5 and 0.65 molecules/100 eV, respectively. Design of an in-reactor creep experiment for graphites of interest to the Molten Salt Breeder Reactor is complete. The test is designed to measure in-reactor creep for graphite samples with a constant compressive load. This experiment is scheduled to begin in the ETR in October, 1969. Author (NSA)

N70-18487# Battelle-Northwest, Richland, Wash.
NUCLEAR CERAMICS: PROPERTIES OF MOLTEN FAST REACTOR OXIDE FUELS
R. P. Nelson, J. J. Rasmussen, O. D. Slagle, and R. E. Nightingale *In its* Reactor Fuels and Mater. Develop. Programs for Fuels and Mater. Branch of USAEC Div. of Reactor Develop. and Technol. Aug. 1969 p 5.1–5.40 refs (See N70-18484 07-22)
Avail: CFSTI

Installation of the high-temperature vacuum resistance furnace in a plutonium glove box was completed. This arrangement will be used for measurements of liquid density, viscosity, surface tension, and compressibility on both unirradiated and irradiated mixed-oxide fuels to 300 C. Techniques are described for obtaining the surface tension of liquid oxides by analyzing the shapes of pendant drops and capillary menisci which was radiographed in closed refractory-metal capsules. Values of the surface tension of liquid Al2O3 found by using these techniques are in good agreement with values reported in the literature. The electric conductivity of $CeO(2-x)$ was measured to 2000 C in argon. The increase in conductivity with a decrease in oxygen content and the anomalous decrease above 1900 C was confirmed. A study was carried out to determine a method of preparing polycrystalline UO2–25 wt % PuO2 creep specimens. Several different mechanically-mixed and coprecipitated powders were compacted and sintered under various conditions, and the resultant microstructures were examined. Results indicate that in order to obtain uniform pellets for creep studies, coprecipitated powders must be used. Author (NSA)

N70-18488# Battelle-Northwest, Richland, Wash.
BASIC SWELLING STUDIES: POSTIRRADIATION EXAMINATION
C. R. Hann and B. Mastel *In its* Reactor Fuels and Mater. Develop. Programs for Fuels and Mater. Branch of USAEC Div. of Reactor Develop. and Technol. Aug. 1969 p 9.1–9.9 (See N70-18484 07-22)
Avail: CFSTI

Swelling was low in specimens of uranium, U–5 wt % Pu, and U–14 wt % Pu–12 wt % Zr irradiated at 1000 psi between 375 C and 625 C. Swelling in U3Si specimens was greater at lower temperatures. When fissionable metals are irradiated, the ordered metallic structure is perturbed in a number of ways. These effects and their interactions are being studied with regard to the influence of irradiation variables such as the specimen temperature, burnup, burnup rate, and external pressure, and with regard to the influence of metallurgical variables such as composition, structure, and geometry. The data thus far obtained have established that swelling at low burnup in alpha uranium is due to mechanical processes associated with the irradiation growth phenomena and with fission-event induced defects rather than with the agglomeration and growth of fission gas pores. This is manifested as a maximum in the swelling-temperature curve in the 400 to 600 C range. Author (NSA)

N70-18490# Battelle-Northwest, Richland, Wash.
IRRADIATION DAMAGE TO REACTOR METALS: REACTOR METALS RESEARCH
L. D. Blackburn *In its* Reactor Fuels and Mater. Develop. Programs for Fuels and Mater. Branch of USAEC Div. of Reactor Develop. and Technol. Aug. 1969 p 12.1–12.75 refs (See N70-18484 07-22)
Avail: CFSTI

A total of 162 tensile, creep, and corrosion specimens were discharged from the ETR at the conclusion of Cycle 100. Core I testing in the ATR was completed. A comparison was made of the stacking fault hardening rates produced by quenching, straining at room-temperature, straining at 700 C, and straining at 700 C followed by a half-hour hold under load at 700 C. The results showed that hardening-rate increased in the order: straining plus hold > straining > quenching and that straining plus hold treatment produced a faster hardening-rate than did straining alone was rationalized in terms of the added effect of vacancy-enhanced diffusion. Discontinuous yielding during neutron irradiation was measured in annealed 304 SS at 370 C stressed to 35,000 psi. This phenomenon, induced by irradiation, resulted in an average creep-rate of 6 × 10 the minus 5th hr to minus 1. The values of the activation parameters and the stress-dependence of the creep-rate in Zr–2.5 Nb are consistent with the dislocation-climb model for creep with short-circuited diffusion. Author (NSA)

N70-18549# Advisory Group for Aerospace Research and Development, Paris (France).
NUCLEAR SPACE POWER SYSTEMS
H. M. Dieckamp *In its* Space Power Systems, Pt. 1 Nov. 1969 p 93–302 refs (See N70-18546 07-03)
Avail: CFSTI

Space power systems using nuclear energy as the energy source are discussed. Analyses of the reactor space power systems are presented including: reactor heat source, heat rejection, system design, vehicle integration, and systems for nuclear auxiliary power (SNAP). The principles and the design of a radioisotope system are described. F.O.S.

N70-18594# American Nuclear Society, Cincinnati, Ohio.
PROCEEDINGS OF THE CONFERENCE ON THE EFFECTIVE USE OF COMPUTERS IN THE NUCLEAR INDUSTRY
Oak Ridge Tenn. Oak Ridge Natl. Lab. [1969] 692 p refs Conf. held at Knoxville, Tenn., 21–23 Apr. 1969 Sponsored by Oak Ridge Natl. Lab. and Tenn. Univ.
(Conf-690401) Avail: CFSTI HC$10.00/MF$0.65

Conference papers pertain to reactor kinetics computations, data processing, multigroup calculations, reactor design systems, hybrid computations, computational techniques, engineering analysis, and Monte Carlo calculations. For individual titles, see N70-18595 through N70-18636.

N70-18595# Massachusetts Inst. of Tech., Cambridge.
REVIEW OF COMPUTATIONAL METHODS FOR SPACE-TIME KINETICS
A. F. Henry *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 3–15 refs (See N70-18594 07-22)
Avail: CFSTI

Approximation techniques for reactor problems are discussed with reference to computer processing. The few group diffusion theory model is outlined. Methods used in solving the space-time equations are described briefly; these include: finite differencing, time synthesis, and space-time synthesis. NSA

N70-18596# Babcock and Wilcox Co., New York.
TART: AN LMFBR TRANSIENT ANALYSIS PROJECT
M. G. Stevenson and B. E. Bingham *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 16–29 refs (See N70-18594 07-22)
Avail: CFSTI

A computer program, TART, for analysis of dynamic characteristics of large LMFBR's is described. The point kinetics and diffusion equations, on which the neutronics part of the computation is based, are given. The thermal-hydraulics, feedback, and primary coolant loops and flow coastdown models, used for the calculation, are described. Typical data resulting from transient calculations for uniform and nonuniform ramp insertions are shown graphically. NSA

N70-18597# General Electric Co., Sunnyvale, Calif. Nuclear Energy Div.
COUPLING OF DYNAMICS CALCULATIONS IN THE FREADM CODE
D. D. Freeman *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 30–50

refs (See N70-18594 07-22)
(Contract AT(04-3)-189)
Avail: CFSTI

The FREADM computer code for fast reactor accidents and excursions analysis is described. The calculational model for the code is summarized. The use of time step control to couple the various dynamic models is detailed. Schematics of transient calculation logic are shown. Results of calculations for a sample test problem are presented in graphic and tabular form. NSA

N70-18598# Argonne National Lab., Ill.
FAST REACTOR ACCIDENT STUDY CODE, SAS-1A
G. J. Fischer, J. C. Carter, T. J. Heames, D. R. MacFarlane, N. A. McNeal et al *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 51–54 refs (See N70-18594 07-22)
Avail: CFSTI

Capabilities and limits of the SAS 1A fast reactor accident analysis code are outlined. The program is written in modular form in FORTRAN 4, and can be used on either the CDC 6600 or IBM 360. The four driver programs to be used with the primary program are described briefly. The principal, or most important, subroutines are summarized. NSA

N70-18601# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
NUCLEAR REACTOR SPATIAL KINETICS CALCULATIONS
G. Buffoni, A. Galati, P. Loizzo, S. Lopez, F. Norelli et al *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 102–115 refs (See N70-18594 07-22)
Avail: CFSTI

The KINEX and ALADINO codes are described. The codes compute the dynamic response of a water cooled reactor to a control rod-induced reactivity input. The KINEX code solves the linear neutron kinetics using the metastatic method; the ALADINO code performs the dynamic response calculations for a given system to the reactivity perturbation. Results of zero power transfer function calculations, using the ALADINO code, are tabulated; the thermohydraulics problems solved by the codes are described. Results of calculations for a sample problem, using the EBWR at high power, are given; data are shown graphically. NSA

N70-18602# Atomic Energy Commission, Washington, D.C. Reactor Physics Branch.
SOME THOUGHTS ON AEC FUNDED CODING
W. H. Hannum and J. W. Lewellen *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 119–129 refs (See N70-18594 07-22)
Avail: CFSTI

Computational capabilities available to the reactor community are summarized. Coordination of code development efforts for reactor analyses is discussed; advantages and disadvantages are analyzed. The task of the recently created ad hoc committee for establishing standard code interfaces is outlined. Objectives of reactor code-development coordination are discussed. NSA

N70-18603# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
THIRD GENERATION COMPUTER USED TO CONTROL FUEL ELEMENT ASSEMBLY
G. E. Cort and R. J. Agosti *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 133–142 (See N70-18594 07-22)
Avail: CFSTI

An example of the use of third generation computers to control the assembly of fuel elements in a nuclear reactor is given. Through a combination of engineering calculations and a business type data handling system to provide checking and quality control monitoring, an individual set of assembly instructions is produced for each unique fuel element. The result is an optimized thermal performance for each solid graphite enriched uranium fuel element which operates within narrow limits of the average core temperature. Many fuel elements with up to a hundred different detail drawing configurations are used in each reactor. Approximatly fifty different input quantities are needed to describe each element. These data are stored on four different magnetic tapes with public READ access, but WRITE access restricted to four different functional groups responsible for processing and updating the information on its own tape. Author (NSA)

N70-18606# Argonne National Lab., Ill.
APPLICATION OF AN IMAGE PROCESSING SYSTEM TO FRAGMENTATION STUDIES
Margaret K. Butler *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 173–192 refs (See N70-18594 07-22)
Avail: CFSTI

Fragmentation experiments are described. In these experiments single drops of materials such as molten tin, lead, bismuth, and UO2 are dropped into reactor coolants such as water and sodium. The degree of fragmentation that ensues is a function of the drop height and/or drop size, and the temperature of the molten metal and the quenching medium. Measures of this fragmentation were made. The information is used in reactor safety heat transfer calculations. The CHLOE hardware and image processing software system was used to facilitate chemical engineering studies of physical and chemical interactions between reactor structural and fuel materials and reactor coolants. A single drop was visually observed to fall from a height of one to four feet into room temperature water when a slight overpressure was applied to the dropper. Particle size measurements were then made on the metal fragments by sieving through wire cloth. NSA

N70-18607# Battelle Memorial Inst., Richland, Wash.
NOISY 1: A PROGRAM FOR CALCULATION OF SPACE DEPENDENT AUTO AND CROSS SPECTRAL DENSITIES IN REACTORS
James R. Sheff *In* Am. Nucl. Soc. Proc. of the Conf. on The Effective Use of Computers in the Nucl. Ind. [1969] p 193–207 refs (See N70-18594 07-22)
(Contract AT(45-1)-1830)
Avail: CFSTI

Numerical analysis of the space-dependent auto and cross spectral density functions for bare cubical reactors is discussed. The NOISY1 computer code, which solves the spectral density functions and neutron detector efficiency equations, is described; the equations and flow diagrams for the program are included. The various features of the NOISY1 program are outlined; subroutines and operation modes are described. The program is written, primarily, in FORTRAN 4 for the Univac 1108; however, several unique features of FORTRAN 5 are included. NSA

N70-18608# Gulf General Atomic, Zurich (Switzerland).
THE APPLICATION OF THE BLOCK INVERSION TECHNIQUE TO MULTI-DIMENSIONAL REACTOR CALCULATIONS
M. R. Wagner *In* Am. Nucl. Soc. Proc. of the Conf. on The Effective Use of Computers in the Nucl. Ind. [1969] p 211–233 refs (See N70-18594 07-22)
Avail: CFSTI

Use of the block inversion technique to obviate the use of reconditioning transformations is discussed. Block inversion is based on initial value treatment, since the flux is expanded at inner mesh points such that the given boundary conditions are satisfied for the homogeneous solution; an iterative technique is used to solve the inhomogeneous problem for the full mesh. The inner

iteration scheme for solving the inhomogeneous multidimensional difference equations is detailed. Numerical stability of the block inversion technique is established. Applications of the block inversion technique are illustrated for both a triangular and a hexagonal mesh. Convergence behavior is described. NSA

N70-18610# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
A TWO-DIMENSIONAL TRANSPORT THEORY PROGRAM IN A MODULAR SYSTEM ENVIRONMENT
Jack P. Friedman and Bruce W. Crawford *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 247–255 refs (See N70-18594 07-22)
Avail: CFSTI

Modular systems concepts are defined and described. Application of the modular system to solution of two-dimensional, multigroup, multiregion reactor physics equations–in the form of the program IT–is described. The equations solved by the IT program are given. Calculational procedures and program specifications are listed. NSA

N70-18611# Comitato Nazionale per l'Energia Nucleare, Casaccia (Italy).
OPTIMIZATION OF THE DOPPLER EFFECT IN A FAST MATERIAL TEST REACTOR BY PROGRAMMING TECHNIQUES
A. Gandini, M. Salvatores, and G. Sena *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective use of Computers in the Nucl. Ind. [1969] p 256–268 refs (See N70-18594 07-22)
Avail: CFSTI

A method is described that adopts the generalized perturbation theory and programming techniques for optimizing reactor integral parameters, linear or bilinear with the real and adjoint neutron densities, after assumption of given constraints. An application of these methods to the optimization of the beryllium distribution with respect to the Doppler effect in a fast ceramic test reactor is shown. Author (NSA)

N70-18618# General Electric Co., San Jose, Calif.
THREE DIMENSIONAL BWR SIMULATION
R. L. Crowther, W. P. Petrick, and A. Weitzberg *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 344–365 refs (See N70-18594 07-22)
Avail: CFSTI

The three dimensional boiling water reactor simulation and organization program (BWR) is described. Methods for input and program execution are described. Computer hardware and software requirements for the program are described. The nuclear and hydraulics models for the programs are described. Results of calculations are given; data are shown graphically. NSA

N70-18619# Electronic Associates, Inc., Princeton, N.J.
HYBRID SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS IN NUCLEAR PLANT SIMULATIONS: A REVIEW
R. Vichnevetsky *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 369–389 refs Prepared in part by Princeton Univ. (See N70-18594 07-22)
Avail: CFSTI

The types of problems related to nuclear power plants which are more easily solved by a hybrid digital-analog computer are delineated. Mathematical bases for the transient field problems arising in nuclear power plants, and the assumptions associated with solutions of these, are summarized; solution of associated boundary value problems are discussed. Applications of the hybrid systems are outlined. NSA

N70-18621# Battelle-Northwest, Richland, Wash.
HYBRID SIMULATION IN FFTF SYSTEM CONCEPTUAL DESIGN
A. L. Gunby and Grant A. Worth *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective use of Computers in the Nucl. Ind. [1969] p 415–432 refs (See N70-18594 07-22)
Avail: CFSTI

The computational models developed for hybrid simulation of the FFTF reactor and process systems are described. The development and descriptions of the models for components, reactor vessel, sodium systems, and heat transport systems are discussed. Results of model calculations are evaluated. NSA

N70-18623# Gulf General Atomic, San Diego, Calif.
COMPUTER INDEPENDENCE OF LARGE REACTOR PHYSICS CODES WITH REFERENCE TO WELL BALANCED COMPUTER CONFIGURATIONS
Reimar Froehlich *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 451–470 refs (See N70-18594 07-22)
Avail: CFSTI

The optimization of computer codes which utilize the multilevel storage systems for reactor physics calculations is discussed. The concept of a well balanced computer configuration is related to a specific computer code; the conventional methods used in obtaining a well balanced configuration are described. Efficient use of multilevel storage hierarchy is discussed. The ideas and equations for the coarse mesh rebalancing techniques are summarized. These coarse mesh techniques are illustrated by considering a TRIGA reactor and an HTGR power reactor; calculated data are presented graphically and in tabular form. NSA

N70-18628# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
AUTOMATED THERMAL ANALYSIS OF NUCLEAR REACTOR COMPONENTS
A. Y. Lee and K. J. Wells *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 519–541 refs (See N70-18594 07-22)
Avail: CFSTI

A description of the computer code AUTOTEM (AUTOmatic TEMperature calculations) is given. It was developed for automating the procedure of modeling and obtaining temperature distributions for a given two-dimensional irregular body with a geometry description such as engineering drawing information as input. The code meshes the solid into a nodal system as required by the heat transfer calculation codes. The nodal system, as generated, is plotted on the SC 4020 data plotter for visual inspection. Temperature distributions are determined using a finite difference numerical solution. From these calculated nodal temperatures isotherms can be plotted for specified temperature values. The AUTOTEM code can handle any two-dimensional or axial symmetrical body consisting of a single material. Time dependent internal heat generation, temperature dependent material thermal properties, and time dependent boundary conditions can be considered. Author (NSA)

N70-18631# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
TRACK 2: A COMPUTER PROGRAM FOR TRANSIENT THERMAL ANALYSIS OF COMPLEX NUCLEAR REACTOR SYSTEMS WITH MULTIPLE PARALLEL AND SERIES FLOW PATHS
M. D. Woods and L. D. Hamlin *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 586–610 refs (See N70-18594 07-22)
Avail: CFSTI

The hydraulic and heat convection calculations are coupled with finite element heat conduction calculations to determine coolant conditions and material temperature distributions in a single computation. The primary application is to perform detailed thermal analyses of nuclear reactor components such as the reflector, the control mechanism, and fuel cluster assemblies under various operating conditions. Two independent groups of coolant channels are permitted and the channels may be arranged in series and

parallel combinations. Additional features include an option for interface conduction between components which are modeled separately and a method to accommodate the effect of fast neutron fluence on component temperature distributions. The formulation for the transient thermal calculations and discussion of the calculational models with emphasis on the application of the capability of TRACK II for thermal, hydraulic analysis of complex systems is presented. The thermal analysis of the reflector system for the XE-PRIME NERVA reactor is presented as an example of this capability. Author (NSA)

N70-18632# Westinghouse Electric Corp., Pittsburgh, Pa. Bettis Atomic Power Lab.

ROBOT: A COMPUTER PROGRAM TO SOLVE THE BOWING PROBLEM IN ROD-TYPE FUEL ELEMENTS (LWBR DEVELOPMENT PROGRAM)

John J. Urbaniak *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 611 – 630 refs (See N70-18594 07-22)
Avail: CFSTI

Mechanisms causing fuel rod bowing in power reactors are described. A mathematical model to describe this bowing is formulated. Use of an iterative technique for computation of rod slippage at the supports is discussed. The deflection and thrust equations solved by the ROBOT program are given. Effects of rod curvature, externally applied forces and moments, internally generated thrusts, thermal expansion, thermal gradient curvature, and fuel-clad interaction are evaluated. NSA

N70-19083# California Univ., Livermore. Lawrence Radiation Lab.

SOME OBSERVATIONS ON 14 MeV NEUTRON RADIATION EFFECTS ON REACTOR MATERIALS

Blake Myers 4 Sep. 1969 36 p refs Presented at the Nucl. Fusion Conf., Abingdon, Bershire, U.K., 17-19 Sep. 1969 Sponsored by AEC
(UCRL-71759-Rev-1; CONF-690901-6) Avail: CFSTI

The damage that might be expected in the structure of a thermonuclear reactor as inferred by the relative number of displaced atoms with 14 MeV neutrons compared with fission neutrons was investigated. It was found that the lower Z materials studied (Be, C, and Al) might be considered from a radiation effects viewpoint for thermonuclear reactor applications on the basis of fission neutron exposure. There is a modest reservation on this judgment as intermediate neutron energies ($1.4 < E < 14.1$ MeV) were not considered. The higher Z materials (Ni, Nb, and Ta) will have, with the thermonuclear neutron bombardment, a maximum of 5 to 8 times the atom displacement rate with fission neutrons at the same flux. These materials are of particular interest for thermonuclear reactors and they should be studied further. A convenient means for such studies seems to be bombardment of these metals with their respective ions or with protons. Author (NSA)

N70-19121 National Lending Library for Science and Technology, Boston Spa (England).

THE DECONTAMINATION OF A REACTOR COOLANT LOOP, DEMONSTRATED AT THE ROSSENDORF WWR-S TYPE RESEARCH REACTOR [DEKONTAMINATION EINES REAKTOR KUEHLWASSERKREISLAUFS AM BEISPIEL DES FORSCHUNGSREAKTORS WWR-S IN ROSSENDORF]

H. Unger et al 18 Jul. 1969 19 p refs Transl. into ENGLISH from Kernenergie (Berlin), v. 11, no. 11-12, 1968 p 285-290 in GERMAN and ENGLISH
(NLL-EE-Trans-1904-(3774.5)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The decontamination of the primary cooling system of the Rossendorf WWR-S type research reactor is described. Detailed investigations of adequate decontaminating solutions resulted in using a solution essentially containing oxalic acid which seemed to be useful for decontaminating a combined loop consisting of austenitic steel and pure aluminum. The maximum effect of decontamination was 94% which was found by measuring the local dose rate in the room of the primary coolant loop before, during, and after decontamination. The data found agrees with that obtained in the laboratory. Author

N70-19148# Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.

YANKEE CORE EVALUATION PROGRAM Quarterly Progress Report, Period Ending 31 Mar. 1969

R. N. Stanutz May 1969 32 p
(Contract AT(30-1)-3017)
(WCAP-3017-6089) Avail: CFSTI

Two advanced SENA-type fuel assemblies were irradiated in Yankee Core V. The assemblies consisted of a 16 by 16 array containing 239 Zircaloy 4 clad fuel rods. Stereo microscopic examination, dimensional measurements, gamma scanning, and leak testing were performed on 9 rods removed following an estimated burnup of 13,500 MWD/MTU. No defects or anamalous conditions were observed. NSA

N70-19195*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NEUTRON AND GAMMA MEASUREMENTS FOR THE NASA PLUM BROOK REACTOR HB-6 BEAM HOLE INSERTION FACILITY

Suzanne T. Weinstein and James A. Kish Washington Feb. 1970 19 p refs
(NASA-TM-X-1962; E-5358) Avail: CFSTI CSCL 18K

The fast and thermal neutron fluxes in the NASA Plum Brook Reactor HB-6 beam hole were measured using standard neutron activation techniques. The gamma ray exposure rate in the beam hole was measured with argon-filled ion chambers. The measurements were made as a function of position along the HB-6 beam. The effects of position across the beam face and of reactor shim rod bank height were also determined. Author

N70-19219# Atomic Energy Commission, Washington, D.C. Div. of Reactor Development and Technology.

USE OF THORIUM IN NUCLEAR POWER REACTORS

Jun. 1969 144 p refs
(WASH-1097) Avail: SOD $1.25

A review of the potential use of Th in power reactors is presented. Different reactor types are analyzed for Th fuel cycles. Characteristics of Th fuel cycles are described. Cost factors and long-range fuel demands and requirements are analyzed for power reactors. Design parameters for a conceptual 1000 MW(e) molten salt breeder reactor are presented. NSA

N70-19230*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMPUTER STUDY OF A DEAD-BAND CONDENSING-PRESSURE CONTROL FOR SNAP-8 STARTUP

Roy C. Tew and James D. Gallagher Washington Feb. 1970 28 p refs
(NASA-TM-X-1964; E-5384) Avail: CFSTI CSCL 21F

A digital-computer simulation of the SNAP-8 space power system was used to evaluate a method for condensing-pressure control during system startup. Mercury-condensing pressure is controlled by varying the condenser-coolant (NaK) flow rate whenever the pressure goes outside a dead-band. Control parameters studied were (1) pressure dead-band width, (2) valve gain defined as rate of change of flow over flow, and (3) initial coolant flow through the condenser. System characteristics studied were (1) the amount of mercury that accumulates in the condenser and (2) the mercury-flow ramp rate. Author

N70-19241# Battelle-Northwest Richland, Wash. FFTF Fuel Development Dept.
SODIUM FLOW TEST OF 7-rod CLUSTER IN SODIUM COMPONENTS EVALUATION LOOP (SCEL)
M. K. Millhollen Sep. 1969 22 p refs
(Contract AT(45-1)-1830)
(NBWL-1075) Avail: CFSTI

A flow test was conducted in which a short, 7-rod fuel cluster, contained within a hexagonal flow duct was subjected to flowing 1060 F sodium for 9000 hr. Velocity of flow over the 304 SS cladding and wire wrap spacers varied from 25 ft/sec at the beginning of the test period to 30 to 31 ft/sec at the end. Interim visual examinations were performed when convenient, and a destructive examination of cladding and spacer wire of one rod was conducted after the test. No unusual wear or severe damage was noted at any location. Minor surface damage to both cladding and wire wrap allowed penetration of sodium along grain boundaries to a depth of approximately 0.001 inch. Author (NSA)

N70-19256# Oak Ridge National Lab., Tenn. Nuclear Div.
OAK RIDGE RESEARCH REACTOR Quarterly Report, Apr.–Jun. 1969
W. H. Tabor and S. S. Hurt, III 1 Oct. 1969 60 p ref
(Contract W-7405-eng-26)
(ORNL-TM-2735) Avail: CFSTI

Operations and maintenance requirements during April to June 1969 are described. Special tests are discussed. Calibration plots for shim rods and flux profiles are included. NSA

N70-19258# Borg-Warner Corp., Vernon, Calif. Byron Jackson Pump Div.
LARGE SODIUM PUMP DESIGN STUDY
Jul. 1969 442 p refs
(Contract AT(04-3)-681)
(SAN-681-1) Avail: CFSTI

Large sodium-cooled fast breeder reactor plants in the 1000 to 1500 MW(e) range require sodium pumps with 4 to 9 times the capacity of existing high-temperature pumps. The primary coolant pump must provide absolute containment and isolation of sodium, have performance reliability, design predictability, and operational safety. A detailed design study is presented which gives pump design parameters for applications bracketing a flow range of 10,000 to 200,000 gpm and dynamic heads of 100 to 450 ft and which shows the interrelation of changing the pump design and/or system conditions. Specifically, included in this parametric study were pump design criteria, preliminary specifications, and the preliminary layout based on a recommended concept for the 60,000 gpm, 350 ft head pump. The range of bearing and seal requirements for bearing and seal test facilities were also established, and auxiliary requirements such as bearing sodium flow and pressure, inert gas, and seal fluids are indicated. NSA

N70-19260# Atomic Power Development Associates, Inc., Detroit, Mich.
AEC SPONSORED ACTIVITIES Quarterly Technical Progress Report, Jan.–Mar. 1969
Mar. 1969 50 p ref
(Contract AT(11-1)-865)
(APDA-236) Avail: CFSTI

Tube wastage by sodium–water reactions in steam generators was examined. Preliminary results are presented for the first of a series of tests on the phenomenon of decreasing metal wastage with increasing leak rate. Instrumentation for acoustic data to be taken during the test series is described. Progress in impurity monitoring and analysis in sodium coolant is summarized. The test program and equipment for evaluating the hydrogen detector are described. Schematic diagrams of the hydrogen detector test loop and gas flow system are included. NSA

N70-19269*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF REACTOR-LOOP TRANSIENTS DURING SNAP-8 POWER CONVERSION SYSTEM STARTUP
Kent S. Jefferies 16 Dec. 1969 22 p refs
(NASA-TM-X-52735) Avail: CFSTI CSCL 18K

From startup tests of a SNAP-8 power conversion system using a realistic reactor simulator, the following conclusions were drawn: The temperature derivatives of the simulator coolant were considerably less than the reactor's limitations during all of the startups. The peak values of reactor-simulator power and outlet temperature approached the reactor's limitations during a few startups. Increasing mercury-flow-ramp duration from 30 seconds to 100 seconds caused a 30 percent reduction of the maximum temperature derivative. Reactivity coefficients determined from tests of the SNAP-8 reactor caused more severe over-shoots of temperature and power than the design coefficients. The over-shoots in temperature and power could be diminished by modifying control drum logic during startup. Author

N70-19275# Oak Ridge National Lab., Tenn. Nuclear Div.
ASSESSMENT OF MOLTEN SALTS AS INTERMEDIATE COOLANTS FOR LMFBR'S
H. F. McDuffie, H. E. McCoy, R. C. Robertson, Dunlap Scott, and R. E. Thoma 3 Sep. 1969 39 p refs Sponsored by AEC
(ORNL-TM-2696) Avail: CFSTI

Several molten salts were considered as intermediate coolants for LMFBR's. Included were fluoride, chloride, carbonate, nitrate-nitrite and fluoroborate salts. Chemical reactions that could occur between sodium and fluoroborates lead to the conclusion that carbonates might be a better choice for LMFBRs. Use of carbonates avoids the safety considerations and related costs that arise from the reactions of sodium with water if a steam generator fails and with air if a coolant pipe ruptures. In the absence of these safety considerations, sodium is clearly superior to the molten salts as an intermediate coolant for LMFBR's because the lower thermal conductivity and higher viscosity of the salts would result in higher equipment costs. Author (NSA)

N70-19278# Naval Research Lab., Washington, D.C. Nuclear Physics Div.
NAVAL RESEARCH LABORATORY REACTOR OPERATIONS REPORT, 1 JULY 1968–30 JUNE 1969
Elbert H. Bebbs, K. W. Marlow, and Richard H. Vogt Sep. 1969 38 p refs
(AD-697295; NRL-MR-2048) Avail: CFSTI CSCL 18/9

The report provides a summary of reactor operations: operational data as well as pertinent information regarding maintenance, modifications, tests and services during the period 1 July 1968 to 30 June 1969. The current status of reactor utilization by in-house and outside users is discussed. Author (TAB)

N70-19325*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CHECK OF A THREE-DIMENSIONAL REACTOR SHIELDING CODE BY COMPARISON WITH ML-1 REACTOR EXPERIMENT
Millard L. Wohl and Robert D. Schamberger Washington Feb. 1970 7 p refs
(NASA-TM-X-1956; E-5017) Avail: CFSTI CSCL 18K

The three-dimensional Monte Carlo reactor shielding code was used to compute the dose rates 500 feet from the center of the ML-1 reactor shield assembly. The ML-1 shield is a high-attenuation unit shield composed of layers of metal and borated water. The agreement between the calculated and measured dose rates was excellent, indicating the validity of using the code for analyzing reactor shield assemblies of similar materials and geometries. Author

N70-19343# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
URANIUM-PLUTONIUM CARBIDE DEVELOPMENT Quarterly Progress Report, Period Ending 30 Jun. 1969
Aug. 1969 54 p refs
(Contract AT(30-1)-3791)
(WARD-3791-40) Avail: CFSTI

Experiments were undertaken to provide additional information on pressing and sintering of plutonium–uranium carbides. Work on the fabrication of pellets for EBR-II irradiation was completed. Routine characterization of potential plutonium–uranium carbide fuel batches continued. A quantity of scrap material from a variety of sources was oxidized and sampled for plutonium and uranium contents. A second group of carbide pellets was examined to assist in phase identification and to determine the degree of homogeneity. Effort was directed to the completion of fabrication of fuel irradiation test capsules for insertion in EBR-II. To obtain post-irradiation axial clad strain data for Type 316 stainless steel cladding, a fiducial marking technique was applied to the outside diameters of all fuel pins except three previously completed. The X-radiographs of three (U,Pu)C capsules were received. The radiographs are complementary to the neutron radiographs completed previously, but the lack of edge clarity prevented precise measurement of pellet dimensions for swelling estimates. Author (NSA)

N70-19344# Oak Ridge National Lab., Tenn.
HIGH FLUX ISOTOPE REACTOR Quarterly Report, Apr.–Jun. 1969
R. V. McCord and B. L. Corbett 24 Sep. 1969 18 p
(ORNL-TM-2734) Avail: CFSTI

Operation and maintenance requirements for HFIR during April to June 1969 are presented. Revised design parameters and operation procedures are described. NSA

N70-19346# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM Quarterly Report, May-Jul. 1969
G. R. Pflasterer and R. A. Becker, comps. Aug. 1969 62 p refs
(Contract AT(04-3)-540)
(GEAP-10010-21; QR-21) Avail: CFSTI

Separate abstracts are included for each of the three sections presented. Topics discussed include: fuel fabrication; startup testing; and SEFOR operation and maintenance. NSA

N70-19359# Sandia Corp., Albuquerque, N.Mex.
SNAP-19 RESIDUAL FIRE TEST
R. E. Berry Aug. 1969 63 p refs
(SC-DR-69-490) Avail: CFSTI

Two residual fire tests were performed on SNAP-19 test items to evaluate the response of the test items to a 30 minute JP-4 fire environment which produces a temperature of about 1850 F at 24 inches above the liquid level. The first test included only a SNAP-19 Dispersion System Generator. The second test included four test items, and each test item was positioned to provide specific fire information on that item. The items were: a Dispersion System Generator; a Dispersion System Capsule; an Intact Reentry Heat Source Generator System; and an Intact Reentry Heat Source Capsule. Author (NSA)

N70-19361# Bettis Atomic Power Lab., Pittsburgh, Pa.
ROBOT: A COMPUTER PROGRAM TO SOLVE THE BOWING PROBLEM IN ROD-TYPE FUEL ELEMENTS (LWBR DEVELOPMENT PROGRAM)
J. J. Urbaniak Jul. 1969 76 p refs
(Contract AT(11-1)-Gen-14)
(WAPD-TM-847) Avail: CFSTI

A computer program is described which includes the following known mechanisms affecting fuel rod bowing: initial rod curvature, externally-applied forces and moments, internally-generated thrusts, thermal expansion, thermal gradient curvature, fuel-clad interaction, and support slippage. The history of deflections of a fuel rod under reactor operating conditions is predicted. Author (NSA)

N70-19363# Oak Ridge National Lab., Tenn.
THORIUM FUEL CYCLE DEVELOPMENT Progress Report
Nov. 1969 14 p refs
(Contract W-7405-eng-26)
(ORNL-TM-2765; PR-4) Avail: CFSTI

Efforts in thorium fuel cycle development directed mostly toward HTGR fuels are summarized. Information is included on development of head-end processes for converting irradiated HTGR fuels to a form suitable for recovery and decontamination of the Th and U by solvent extraction. Results of engineering studies of processes and equipment for preparation of ThO2-UO3 sols are summarized along with efforts devoted to sphere forming column chemistry. Other work is reported on fueled graphite particle coating, particle handling, fuel fabrication, fuel element assembly, and inspection. Work on irradiation capsule design, and U-233 processing is also reported. NSA

N70-19368# Institute of Nuclear Research, Warsaw (Poland).
FUEL TEMPERATURE TRANSIENTS IN EWA-2 AND EWA-4 CORES AT FLOW FAILURE AND RAMP REACTIVITY ADDITION TESTS
M. Czerniewski and L. Labno 1969 30 p refs In ENGLISH and POLISH
(INR-1090) Avail: CFSTI

A program for EK-10 type fuel rod temperature measurements was performed in the EWA-2 and EWA-4 cores. The behavior of the reactor during transient states was investigated in two series of measurements. In the first series an open box type of the fuel assemblies for the core of 2 MW power reactor were used. The second series was performed with the fuel assemblies equipped with Venturi tubes inside of which the fuel rods had been placed. This type of fuel assemblies is used for the core of a 4 MW power reactors. Results are described. Author (NSA)

N70-19372# California Univ., Livermore. Lawrence Radiation Lab.
APPLICATIONS OF A PHOTOMICROSCOPIC TECHNIQUE TO THE PARTICLE SIZE ANALYSIS OF A SAMPLE FROM A NUCLEAR CRATERING CLOUD
Gerald F. Rynders 4 Sep. 1969 24 p refs Presented at the 2d Ann. Tech. Meeting of Intern. Metallographic Soc., San Francisco
(UCRL-71837; CONF-690920-3) Avail: CFSTI

A particle size distribution was obtained for a sample, collected by an aircraft from a cloud resulting from a nuclear cratering experiment. Because of the large size range of particles encountered in the initial sample, a sedimentation technique was employed to reduce the range in a particular counting field. A photomicroscopic technique in conjunction with a Zeiss Particle Size Analyzer was used. The distribution obtained, while essentially log-normal, could also be fitted to an exponential relationship. A number of subpopulations were observed which would be expected to have separate distributions although these were not evaluated. Errors of restricted sample size were attached to the final values. Recommendations are presented for further improvement of such analysis. Author (NSA)

N70-19377# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
FISSION PRODUCT TRANSPORT PROCESSES IN REFRACTORY METAL FUEL SYSTEMS
P. K. Conn and E. C. Duderstadt May 1969 74 p refs

(Contract AT(40-1)-2847)
(GEMP-682) Avail: CFSTI

Broad studies were conducted on refractory metals and refractory metal-clad W-CO2 cermet core fuel elements to gain a better understanding of fission product transport processes in these systems and their effect on leak-free life of such fuel elements. The observed distribution was 65 to 80% in UO2 particles, and 14 to 23% in the W-matrix, with 5 to 15% of the gas having mobility in connected pores and channels. The mobile gas was released from the UO2 phase at temperatures exceeding 650 to 700 C. The dominant factors which determine the leak-free life of refractory metal clad-cermet core fuel element specimens having relatively large cladding-to-core ratios (0.12 to 1.1) appeared to be burnup, irradiation temperature, and the creep-rupture properties of the core and cladding. Demonstrated leak-free life, of small nonprototypic fueled assemblies, is dependent on cladding material; the order of decreasing leak-free life was: Ta-10W, Ta and W-30Mo-30Re (atom percent). NSA

N70-19378# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
THERMAL FLUX IRRADIATION STUDIES OF (U, Pu)C FUEL DESIGN, FABRICATION AND REACTOR INSERTION OF FUEL PINS AND CAPSULES
Apr. 1969 34 p refs
(Contract AT(30-1)-3791)
(WARD-3791-16) Avail: CFSTI

Nine fuel pins with 3 variations of (U,Pu)C pellets and bonded with liquid sodium were designed and fabricated for irradiation in a thermal neutron flux. The objective of the experiment is to evaluate the in-pile performance of sodium-bonded carbide fuel pins. The variations in fuel include Cr23-C6-modified Fe-modified, and unmodified pellets of a nominal 89% of theoretical density. The cladding is 316 and 304 stainless steel. Three fuel pins are stacked axially in each of 3 instrumented double-containment capsules. Nominal irradiation parameters include fuel power ratings up to 30 kW/ft and target burnups to 50,000 MWd/t. Control of the experiment is accomplished by monitoring capsule thermocouples and subsequent adjustment of in-reactor facility tubes to maintain near-constant power rating on the high-power pins. Author (NSA)

N70-19391# Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center.
CHORD-S: A SYSTEM OF PROGRAMS FOR COMPUTER HANDLING OF REACTOR DATA FOR SAFETY
Marilyn J. Magnuski 3 Dec. 1968 46 p Revised
(Contract W-7405-eng-26)
(CTC-INF-32-Rev-1) Avail: CFSTI

The computer aspects of a growing system of programs written to facilitate the evaluation of nuclear reactor specifications are analyzed. In the input phase, an MT/ST device is used to create taped card images. These are then used to update a master tape which in turn yields the information needed to write a data call file. Terminal programs written for the IBM-360 query the file and retrieve various classes of information ranging from very general indicators of the contents of the file to specific information about a particular reactor. Responses to queries are printed out in one of several formats according to the wishes of the user. Author (NSA)

N70-19397# Gulf General Atomic, San Diego, Calif.
BUG-2/BUGTRI: TWO DIMENSIONAL MULTIGROUP BURNUP CODES FOR RECTANGULAR AND HEXAGONAL GEOMETRY
J. P. Dorsey, R. Froehlich, and F. Todt 22 Aug. 1969 235 p refs
(Contract AT(04-3)-167)
(GA-8272) Avail: CFSTI

The BUG-2 and BUGTRI codes and their use are described. Both BUG-2 and BUGTRI are UNIVAC-1108 two dimensional neutron diffusion-depletion programs which calculate the spatial distribution of the neutron flux, effective multiplication factor, and spatial composition of a reactor for a period of time and for the reactor operating conditions specified by the user. Flux, power distribution and multiplication factor are computed using a non-uniform X-Y or R-Z mesh with BUG-2 or a uniform triangular mesh with BUGTRI. The diffusion programs each permit up to 20,000 meshpoints, as many as 255 different spatial regions having uniform macroscopic cross sections, and from one to ten energy groups with arbitrary group-to-group scattering. Author (NSA)

N70-19399# Atomics International, Canoga Park, Calif.
SPECTRUM SYNTHESIS IN FAST REACTOR ANALYSIS
E. U. Vaughan, P. F. Rose, and D. F. Hausknecht 30 Jun. 1969 106 p refs
(Contract AT(04-3)-701)
(AI-AEC-12820) Avail: CFSTI

The synthesis method has been applied to fast reactor calculations in the form of spectrum synthesis, in which the neutron distribution in a region is represented approximately as a linear combination of a few predetermined energy spectra (the basis spectra), the coefficients being space-dependent functions (the mixing functions). Equations to determine the mixing functions are obtained in several ways which include the standard variational and Galerkin methods, and the group balance method in which the original multigroup equations are replaced by conditions of neutron balance in a number of coarse groups equal to a form suitable for solution by the one-dimensional, few-group, diffusion-theory code RAUM, which has been generalized by relaxing the restrictions that the matrix of diffusion coefficients by diagonal and the scattering transfer matrix be triangular. Author (NSA)

N70-19400# Institute of Nuclear Research, Warsaw (Poland).
MACROSCOPIC NEUTRON DISTRIBUTION IN ANNA REACTOR LATTICES
L. Adamski, K. Jozefowicz, E. T. Jozefowicz, and A. I. Eichen 1969 30 p In ENGLISH and POLISH
(INR-1058) Avail: CFSTI

The results of measurements of thermal neutron, epithermal neutron, and spectral parameter distributions in four regular lattices of the zero-power ANNA reactor are presented. The distributions were measured along the vertical experimental channels, along two perpendicular horizontal axes and in the horizontal plane of symmetry of the core. The axial buckling values were determined. Author (NSA)

N70-19405# Argonne National Lab., Idaho Falls, Idaho.
CONCEPTUAL SYSTEM DESIGN DESCRIPTION OF THE EBR-2 IN-COR INSTRUMENT TEST FACILITY
O. Seim, E. Hutter, T. Sullivan, R. Olp, J. Pardini et al Jun. 1969 70 p
(Contract W-31-109-eng-38)
(ANL-EBR-4) Avail: CFSTI

The results of a feasibility study for an EBR-2 test facility for studying reactor operating-conditions effects on instrumentation and cabling are discussed. Requirements for the experimenter's criteria are outlined. A brief description of the EBR-2 is given. Methods of heating and cooling the experimental thimble assembly are discussed and evaluated. Sensor test temperature analyses are detailed; calculated data are shown graphically. Methods for data acquisition and sensor calibration are described. Safety aspects of the test loop are evaluated. NSA

N70-19424# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM
Annual Report

31 Mar. 1969 369 p refs
(Contract AT(40-1)-2847)
(GEMP-1012-Pt-2; AR-8) Avail: CFSTI

The research and development in nuclear reactor fuels and materials are reported. Topics included are: (1) advance pressure vessel material; (2) fast breeder control, shield, cladding, and refractory materials; (3) reactor safety, and (4) evalulation of pp plastic fatigue properties of heat resistant alloys. F.O.S.

N70-19425# Gulf General Atomic, San Diego, Calif.
CRECOL: A COMPUTER PROGRAM FOR ESTIMATING CREEP DEFORMATION OF SLIGHTLY OVAL TUBES
H. C. Hopkins and D. R. Buttemer 1 Aug. 1969 53 p refs
(Contract AT(04-3)-167)
(GAMD#9623) Avail: CFSTI

The computer code CRECOL is described and background information on this code is included. CRECOL analyzes the creep-deformation with time of a slightly oval tube when subject to an external pressure. The code was developed to predict the behavior of the fuel rods in the gas-cooled fast reactor where minimizing clad wall thickness consistent with satisfactory performance is desirable. Only the material properties for Hastelloy X and 316SS in the unirradiated conditions are incorporated in this version. Author (NSA)

N70-19429# Atlantic Richfield Hanford Co., Richland, Wash.
PROBLEMS ASSOCIATED WITH Pu 238 PROCESSING
A. H. Case Jul. 1969 10 p refs
(Contract AT(45-1)-2130)
(ARH-1154) Avail: CFSTI

Because of its greater disintegration rate, plutonium-238 processing presents some problems that are not found in working with plutonium-239. These problems and special equipment and techniques that have been used successfully are described. Author (NSA)

N70-19432# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
CALCULATED DAMAGE FUNCTIONS FOR DETERMINING IRRADIATION EFFECTIVENESS
G. E. Russcher Sep. 1969 28 p refs
(Contract AT(45-1)-1830)
(BNWL-1093) Avail: CFSTI

Data are provided for a technique which can be used by development engineers or designers to estimate the effectiveness of two or more reactor spectra in producing irradiation damage. Using this technique permits the calculation of the fluence in a reactor environment under design that is equivalent to the fluence which produced a measured materials property change in an irradiation environment. Included is a tabulated irradiation damage function that can be used to correlate irradiation spectra in terms of their relative effectiveness in producing damage. Two damage weighting functions have also been tabulated. Author (NSA)

N70-19453# Atomics International, Canoga Park, Calif.
STUDIES OF BOILING INITIATION FOR SODIUM FLOWING IN A HEATED CHANNEL
D. Logan, C. J. Baroczy, J. A. Landoni, and H. A. Morewitz 30 Sep. 1969 133 p refs
(Contract AT(04-3)-701)
(AI-AEC-12767) Avail: CFSTI

Data are presented for incipient boiling superheat for sodium flowing upward in a vertical annulus formed by a heated stainless steel tube of 1/4-in. diameter located inside a tube of 1/2-in. diameter. The data cover the following ranges: heat flux, 9000 to 83,500 Btu/hr-sq ft; pressure, 2 to 15 psia; inlet subcooling, 20 to 300 F; sodium velocity, 2 to 8 ft/sec; and wall superheat 0 to 241 F. All-liquid heat transfer relationships permit clear identification of the major trends due to heat flux, velocity, and inlet subcooling and thereby allow improved interpretation of the incipient boiling data. The application of various boiling inception theories to forced convection, liquid metal systems is examined and evaluated. For the maximum observed superheats, consideration of the dominant physical forces results in a dimensionless plot of wall superheat vs Reynolds number and shows the trends to be expected for forced convection laminar and turbulent flow in LMFBR systems. Author (NSA)

N70-19455# Institute of Nuclear Research, Warsaw (Poland).
TIME MEASUREMENTS IN THE REACTOR SYSTEMS
S. Chwaszczewski 1968 108 p refs In POLISH
(INR-1045) Avail: CFSTI

Pulsed neutron measurements and their interpretation in critical assemblies are presented. The theory and measurements of the reactor kinetic parameters using the analysis of the statistical properties of the count sequence from the neutron detector placed in a reactor are described. The theory and measurements of the neutron slowing down and diffusion parameters in moderating media using a pulsed neutron source are presented. Experimental equipment used in the described measurements is described. Author (NSA)

N70-19457# California Univ., Livermore. Lawrence Radiation Lab.
MULTIPLE FAILURES OF MTR-TYPE FUEL ELEMENTS AT THE LPTR
James L. Eagan 10 Sep. 1969 21 p refs Presented at Am. Nucl. Soc. Conf. on Reactor Operating Experience, San Juan, Puerto Rico, 1-3 Oct. 1969 Submitted for publication Sponsored by AEC
(UCRL-71736; Conf-691009-4) Avail: CFSTI

Fuel element failures in the Livermore Pool-Type Reactor during 1968 and 1969 are analyzed. Photographs of the failed and damaged fuel elements are included. NSA

N70-19468# Sandia Corp., Albuquerque, N.Mex.
HELIUM: A COMPUTER PROGRAM TO CALCULATE THE HELIUM RELEASED IN FUEL CAPSULES CONTAINING ALPHA-EMITTING ISOTOPES
C. J. M. Northrup, Jr. and S. M. Milly Oct. 1969 163 p refs
(SC-RR-69-502) Avail: CFSTI

HELIUM is a computer program which calculates gas pressures and quantities of helium in fuel capsules containing alpha-emitting isotopes. The program assumes that the transport mechanism for helium in the fuel particles may be described by classical diffusion. The volume of individual fuel particles must be small compared to the volume of the thermal nodes. Vacancy clusters, voids, and other materials defects are not treated explicitly and are accounted for only to the extent that they affect the diffusion coefficients. Both vented and unvented systems can be analyzed, with the computer output consisting of both printed listings and graphic plots. The program is written in Fortran IV for the CDC 6600 computer and utilizes the SCORS plotting routines to produce an output file for the S-C 4020 plotter. Author (NSA)

N70-19474# Atomics International, Canoga Park, Calif.
LMFBR SAFETY PROGRAMS (GFY 1969) Annual Technical Progress Report
1969 42 p refs
(Contract AT(04-3)-701)
(AI-AEC-12858) Avail: CFSTI

Research and development in reactor safety are reported. Included are: accidents in liquid metal fast breeder reactors, analysis of uranium oxide, and combustion of sprays of liquid sodium. NSA

N70-19511# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
ADVANCED TERRESTRIAL RADIOISOTOPE POWER

SYSTEMS Quarterly Progress Report, 1 Jun.-31 Aug. 1969
W. S. Wilgus Sep. 1969 128 p
(Contract AT(30-1)-3800)
(WANL-3800-37; WANL-PR-SS-31) Avail: CFSTI

Life testing of the Electrical Mockup System (EMS) continued during the report period. A performance data summary for this test program is included. Progress on design of the Fueled Prototype Mockup System (FPMS) is summarized. Performance data on the PMC series converters are also summarized. Design and development of SNAP-23A fuel capsule 23-4 is reported. Materials testing results are included in summaries on spherical insulation tests, thermal grease tests, impact tests on U-8Mo, galvanic corrosion testing of Al and Inconel 625, and tests of long term compatibility between materials used in the conversion systems. Results of safety analyses conducted for the SNAP-23A systems are included. NSA

N70-19519# Los Alamos Scientific Lab., N.Mex.
ULTRA HIGH-TEMPERATURE REACTOR EXPERIMENT (WHTREX) Quarterly Status Report, Period Ending 31 Jul. 1969
26 Sep. 1969 16 p refs
(Contract W-7405-eng-36)
(LA-4272) Avail: CFSTI

Operations and testing programs in the Los Alamos Turret Reactor during May to July 1969 are described. 2 references. NSA

N70-19530# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
OXIDE FUEL ELEMENT DEVELOPMENT Quarterly Progress Report, Period Ending 30 Jun. 1969
Aug. 1969 45 p refs
(Contract AT(30-1)-3791)
(WARD-3791-39; QPR-4) Avail: CFSTI

Activities in parallel analytical and experimental studies on mixed oxide fuel pins are reported. Analysis of clad swelling data for solution treated type 304 stainless steel continued. The range of applicability was extended to temperatures greater than 550 C. The OLYMPUS IB code was selected as the model to be currently used for design purposes. This version can use either the Westinghouse-PNL agreed clad swelling equation or the Westinghouse F-2 equation. Improvements in the code are now in progress. The development of a fuel lifetime code was continued with emphasis on evaluating the mechanical models in CYGRO. Literature reviews and data analyses were initiated on a study of the effects of irradiation on the creep strength of stainless steels with particular emphasis on Type 316. Thermal and nuclear design of the two 19-capsule subassemblies was begun. Approval-in-principle of this program has been received from the AEC. Author (NSA)

N70-19531# Minnesota Mining and Mfg. Co., St. Paul, Minn. Electrical Products Group.
SNAP-23A PROGRAM. PHASE 1: THERMOELECTRIC CONVERTER DEVELOPMENT PROGRAM Quarterly Report, 1 Apr.-30 Jun. 1969
31 Jul. 1969 89 p refs
(Contract AT(30-1)-3824)
(MMM-3824-37; QR-10) Avail: CFSTI

The development of a thermoelectric converter to be used in the 60 W SNAP-23A terrestrial radioisotope power supply system is reported. The design details were specified following experimental studies of the machinability of Inconel 625 and Min-K-2002, welding materials and methods, and the performance and leak requirements of the power cable. Life testing was continued to determine the long-term performance of several converters with 6- and 10-couple modules. NSA

N70-19534# Battelle-Northwest, Richland, Wash.
THE 2DB USER'S MANUAL: REVISION 1
W. W. Little, Jr. and R. W. Hardie Aug. 1969 142 p refs Revised
(Contract AT(45-1)-1830)
(BNWL-831-Rev-1) Avail: CFSTI

The 2DB is a two-dimensional (X-Y, R-Z, R-theta, triangular), multigroup diffusion code for use in fast reactor criticality and burnup analysis. All programming is in FORTRAN-4. Since variable dimensioning is employed, no simple restrictions on problem complexity can be stated. However, in a 65K memory, the current version is nominally restricted to 50 energy groups. Running time (for a k sub eff calculation) on a UNIVAC 1108 is about 1 minute for a 30 × 30 mesh problem using 4 energy groups. Author (NSA)

N70-19536# Oak Ridge National Lab., Tenn.
OPERATING MANUAL FOR THE 2 MW BULK SHIELDING REACTOR
R. A. Costner, Jr., W. H. Culbert, S. S. Hurt, III, and W. H. Tabor 5 Aug. 1969 559 p refs
(ORNL-TM-2676) Avail: CFSTI

The BSR is a swimming-pool-type reactor. It has the capabilities of continuous operation at a power level of 2 MW or at any desired lower power level. Descriptive and operational information is presented. The reactor and its ancillary facilities are described from a physical and operational viewpoint. Detailed operating procedures are included which are applicable from source-level startup to full-power operation. Also included are procedures relative to the safety of personnel and equipment in the areas of experiments, radiation and contamination control, emergency actions, and general safety. Author (NSA)

N70-19537# Battelle-Northwest, Richland, Wash.
STRUCTURE AND PROPERTIES OF (U, Pu)O2 CONTAINING INACTIVE FISSION PRODUCTS. A SIMULATION OF IRRADIATED NUCLEAR FUEL
Franz Schmitz 10 Sep. 1969 38 p refs Transl. into ENGLISH from CEA report CEA-R-3795, Apr. 1969
(BNWL-tr-43; CEA-R-3795) Avail: CFSTI

Oxides with the same uranium and plutonium content, the same stoichiometry and the same fission product content as an oxide fuel (U(0.8)Pu0.2)O(1.96) after 2 per cent burnup were prepared. The stoichiometry changes due to irradiation were calculated and the calculation using X-ray parameter measurements were checked. The contraction of the oxide lattice due to fission products in solid solution was calculated and measured. Microprobe analysis of precipitates was made and the results used to identify nonmetallic barium containing compounds and showed the particular behavior of molybdenum. Physical properties such as the electrical resistivity, the thermal diffusivity, and the vapor pressure of zirconium in solid solution were measured. Author (NSA)

N70-19544# Gulf General Atomic, San Diego, Calif.
HTGR BASE PROGRAM Quarterly Progress Report, Period Ending 31 Aug. 1969
25 Sep. 1969 110 p refs
(Contract AT(04-3)-167)
(GA-9660) Avail: CFSTI

Research related to the preliminary design and exploratory development of a 1000 Mw(e) prototype is reported. The following areas of investigations are discussed: electric motor drive, reactor controls, PCRV design; core thermal performance code; fission product diffusion studies; fuel refabrication and recycle test elements; head-end reprocessing, and TRISCO and BISCO coated fuel particle stability during fluid bed oxidation; use of plutonium fuel and advanced fuel test elements; fission product release from coated particle fuels; and graphite research. N.E.N.

N70-19549# Douglas United Nuclear, Inc., Richland, Wash.
FIRE ENGINEERING FOR NUCLEAR PLANTS
H. C. Crose and R. C. Hoffman 27 Oct. 1969 22 p Presented at the 17th Conf. on Remote Systems Technol., San Francisco

(Contract AT(45-1)-1857)
(DUN-SA-122; Conf-691102-2) Avail: CFSTI

Fire protection for nuclear power plant control rooms, electrical systems, electronic systems, and associated wiring is discussed. Methods for controlling fire damage through plant design, training programs, and planning are described. Combustion characteristics of materials used in controls, instrumentation, and wiring are examined, and fire control and extinguishing agents are evaluated. Backup fire protection for essential plant controls and systems is discussed. NSA

N70-19584# Oak Ridge National Lab., Tenn.
CHEMICAL TECHNOLOGY DIVISION Annual Progress Report, Period Ending 31 May 1969
Oct. 1969 356 p refs
(Contract W-7405-eng-26)
(ORNL-4422) Avail: CFSTI

Reports are presented on research carried out in several areas of investigation. The topics include the following: molten salt reactor processing; aqueous processes for fast reactor fuels; processing HTGR fuels; waste treatment and disposal; transuranium element processing; thorium fuel cycle; sol gel processes for the uranium fuel cycle and isotopic heat sources; chemical applications of nuclear explosions; biochemical separations; irradiation effects on heterogeneous systems; spectrophotometric studies of soltuions of lanthanides and actinides; preparation and properties of actinide oxides; carbides, nitrides, and carbonitrides; fuel transport safety; stacked clone contactor development; and facilities siting. N.E.N.

N70-19586# Argonne National Lab., Ill.
CHEMICAL ENGINEERING DIVISION Annual Report, 1968
Apr. 1969 180 p refs
(Contract W-31-109-eng-38)
(ANL-7575) Avail: CFSTI

Experimental studies in nuclear chemistry and thermochemistry for the improvement of reactor fuels are presented. The areas covered include: fluidization and volatility process, energy conversion, determination of burnup of fast reactor fuels, materials chemistry and thermodynamics, compact pyrochemical processes, reactor safety, and nuclear constants. J.M.C.

N70-19587# General Electric Co., San Jose, Calif. Reactor Fuels and Reprocessing Dept.
ZIRCALOY-CLAD UO2 FUEL ROD EVALUATION PROGRAM Quarterly Progress Report, Feb.-Jul. 1969
F. H. Megerth, comp. Aug. 1969 20 p refs
(Contract AT(04-3)-189)
(GEAP-10079; QPR-6; QPR-7) Avail: CFSTI

Longitudinal tensile coupon specimens obtained from the cladding of several fuel rods were tested at room temperature, 343, 399, and 454 C. The high temperature ultimate strength ranged from about 5000 kb/sq cm at 343 C to about 3000 kb/sq cm at 454C. These values represent a total radiation-induced strength increase of approximately 1000 to 2500 kb/sq cm. Increases in yield strength were comparatively greater; the differences between ultimate strength and yield strength in the irradiated material were generally less than or equal to 70 kb/sq cm in the high temperature tests. The total and average uniform elongations of the unirradiated archive material were measured at 343 to 454 C. There were no distinct differences in the ultimate-yield strength differential or in the uniform elongation. Similarly, microhardness measurements on current SA-1 cladding specimens indicated some increase in hardness when compared with specimens from fuel cycle program fuel rods whose exposure was limited to VBWR operation. Author (NSA)

N70-19589# Battelle-Northwest, Richland, Wash.
REACTOR FUELS AND MATERIALS DEVELOPMENT PROGRAMS FOR FUELS AND MATERIALS BRANCH OF USAEC DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY Quarterly Progress Report, Oct.-Dec. 1968
A. L. Bement, G. J. Dau, E. A. Evans, and R. E. Nightingale Feb. 1969 272 p refs
(Contract AT(45-1)-1830)
(BNWL-971) Avail: CFSTI

Progress in the development of reactor fuels and materials is presented. Nondestructive methods for testing reactor fuel and materials are described. Microstructural changes in nuclear graphite were determined from electron microscopic studies. Other areas of concentration included fuel development for gas cooled reactors, nuclear ceramics, fast reactor nitride research, and supporting studies for fast reactors. J.M.C.

N70-19595# Oak Ridge National Lab., Tenn.
UNIT OPERATIONS SECTION Quarterly Progress Report, Oct.-Dec. 1967
M. E. Whatley, P. A. Haas, L. E. Mc Neese, A. D. Ryon, and D. C. Watson Oct. 1969 82 p refs
(Contract W-7405-eng-26)
(ORNL-4235) Avail: CFSTI

Research progress is reported on chemical engineering research, engineering separation of macromolecular and biological substances, sol-gel process development, thorium fuel cycle studies, power reactor fuel processing, and molten-salt reactor processing studies. NSA

N70-19598# Institute of Nuclear Research, Warsaw (Poland).
PRELIMINARY CALCULATIONS OF THE HYDROCYCLONE CONTACTOR TYPE MPH
Przemyslaw M. Hoffmann 1969 22 p In POLISH
(INR-1068) Avail: CFSTI

The necessity of reprocessing highly burned up nuclear fuels requires new technological solutions. This problem can be solved by minimizing the time of contact between the aqueous and organic phases in the solvent extraction process. Centrifugal contactors allow the time of contact to be reduced by 2 to 3 orders of magnitude. Theoretical considerations concerning a centrifugal extractor of the type mixer-pump-hydrocyclone in which the time of contact between the phases is about 4 sec and the efficiency 1 l/min, are given. Author (NSA)

N70-19603# Atomics International, Canoga Park, Calif.
LMFBR PHYSICS PROGRAMS, GFY 1969 Annual Technical Progress Report
T. H. Springer, R. J. Tuttle, and H. N. Royden 30 Sep. 1969 71 p refs
(Contract AT(04-3)-701)
(AI-AEC-12857) Avail: CFSTI

Continuing progress on reactor experiments, analysis, and measurements are reported. Experimental activities with the LMFBR concentrated on reactor compositions and spectra typical of current designs, permitting investigation of problems such as reactivities of pin-clusters of absorbers, strongly self-shielded absorbers, and individual plutonium isotopes. Preliminary versions of codes using Monte Carlo techniques for calculating fast reactor physics and safety problems are described, and results are presented for fission and total inelastic cross section data, discrete level inelastic data, (n,2n) data, and evaporation model cross sections. Coding efforts are reported for a man-computer interactive neutron cross section data evaluation system and for the testing, evaluating of the cross section data and optical model development. Reactor measurements were made on neutron spectra using proton recoil detectors, and neutron spectra in sodium and steel. N.E.N.

N70-19610# Gulf General Atomic, San Diego, Calif.
PARAMETRIC STUDY OF MULTIPLE-COLUMN SEISMIC SUPPORT FOR A LARGE PCRV
P. D. Smith 7 May 1969 69 p refs
(Contract AT(04-3)-167)
(GAMD-9281) Avail: CFSTI

Design requirements for multiple column supports of large prestressed concrete reactor pressure vessels are analyzed. Seismic stress analyses are included for supports of various configurations.
Author (NSA)

N70-19621# Scientific Translation Service, Ann Arbor, Mich.
FAST NEUTRON SHIELDING BY ORDINARY CONCRETE
P. F. Sauermann and W. Schaefer [1968] 6 p refs Transl. into ENGLISH from Atompraxis, (Karlsruhe), v. 14, no. 7, Jul. 1968 2 p Prepared for Oak Ridge Natl. Lab.
(ORNL-TR-3028) Avail: CFSTI

The attenuation of fast neutrons in normal concrete was measured for nine neutron energies between 140 keV and 14.2 MeV with the Rem counter of Anderson and Braun and for 14.2 MeV with the recoil proton counter of Dennis and Loosemore. The dose exposure attenuation coefficient as well as linear expansion was calculated from the slope of the attenuation curve.
Author (NSA)

N70-19626# Atomics International, Canoga Park, Calif.
THE EFFECT OF AEROSOL AGGLOMERATION ON THE REDUCTION OF THE RADIOLOGICAL SOURCE TERM FOR THE LMFBR DESIGN BASIS ACCIDENT
R. L. Koontz, R. S. Hubner, and M. A. Greenfield 15 Sep. 1969 93 p refs
(Contract AT(04-3)-701)
(AI-AEC-12837) Avail: CFSTI

Calculations of the stirred settling rate of particles with heterogeneous distributions characterized as log normal are presented. The data are presented in a form which allows one to estimate the fractional decrease of the initial concentration versus time for a given distribution. A log-normal distribution is completely characterized by the median size and geometric standard deviation. Additional data are presented which allows one to determine the leaked fraction of the mass which is released into a vessel as a function of time for a given distribution. Finally, an empirical relation is suggested for estimating the median particle size produced by agglomeration of initial particles as a function of the mass introduced into the test chamber. The settling velocities are computed on the base of Stokes Law.
Author (NSA)

N70-19629# Mound Lab., Miamisburg, Ohio.
SNAP-19 B (IRHS) RECOVERED HEAT SOURCES Final Report
D. E. Loyer and C. H. Davenport 15 Sep. 1969 59 p ref
(Contract AT(33-1)-Gen-53)
(MLM-1659; TID-4500) Avail: CFSTI

Two SNAP-19B (IRHS) heat sources which had fallen into the Pacific Ocean on May 18, 1968, as a result of the abort of a NIMBUS-B satellite were recovered on October 9, 1968. A health physics survey of the sources revealed no release of radioactivity. A set of procedures for extensive examination of the two capsules was prepared. The heat sources were radiographed and photographed in the as-received condition. The radiographs indicated that the fuel was agglomerated, but was still contained within the capsule. Since the start of the examination on January 9, 1969, both heat sources were disassembled; the fuel was removed and fully characterized; fines analyses were conducted on free-flowing fuel from each capsule; heat source components were metallographically examined; and vents were flowchecked and metallographically examined. The examination revealed that while the fuel sintered due to being exposed to high temperature for a prolonged period of time, no other changes in the fuel occurred.
Author (NSA)

N70-19639# Idaho Nuclear Corp., Idaho Falls.
SIMULATED DESIGN BASIS ACCIDENT TESTS OF THE CAROLINAS VIRGINIA TUBE REACTOR CONTAINMENT: PRELIMINARY RESULTS
J. A. Norberg, G. E. Bingham, R. C. Schmitt, and D. A. Waddoups Oct. 1969 58 p refs
(Contract AT(10-1)-1230)
(IN-1325) Avail: CFSTI

Simulated design basis accident (DBA) tests were performed on the containment system of the recently decommissioned Carolinas Virginia Tube Reactor. Preliminary data of the pressure-temperature response of the containment system to the simulated DBA conditions are presented and compared to analytical predictions of the containment response. The pressure reduction sprays were demonstrated to be effective in reducing the containment pressure.
Author (NSA)

N70-19640# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
FABRICATION OF SWELLING RESISTANT URANIUM METAL FUEL RODS FOR THE CANADIAN WHITESHELL REACTOR, WR-1
W. E. Gurwell, T. B. Correy, and J. O. Vining Aug. 1969 94 p
(Contract AT(45-1)-1830)
(BNWL-1129) Avail: CFSTI

Metallic uranium has properties that make it an attractive fuel material for organic-cooled reactors, where the consequences of fuel rupture are not nearly so severe as in water-cooled reactors. Uranium swelling can be accommodated by a properly designed internal void. Studies were made on an optimum fuel design that had center temperatures in the 500 to 700 C range and average exposures of 7000 MWd/ton. One hundred thirty-four fuel rods with various combinations of void volume, geometry, and cladding thickness were fabricated for the experiment. Half of the rods were pellet filled and one-half were coextruded. A technique for coextruding fuel rods with small axial holes one-eighth inch in diameter was demonstrated to be economically feasible.
Author (NSA)

N70-19651# Gulf General Atomic, San Diego, Calif.
PWCOST: A GENERAL PURPOSE COMPUTER CODE FOR THE CALCULATION OF FUEL CYCLE COSTS
D. H. Lee, Jr. 10 Jun. 1969 115 p
(Contract AT(04-3)-167)
(GA-9394) Avail: CFSTI

PWCOST is a very flexible computer program for calculating nuclear reactor fuel cycle costs. It can be used for evaluating costs of a single fuel segment or for an entire reactor history. Input for all components of the fuel cycle are time dependent. Working capital charge rates may be specified separately for in-core and out-of-core time periods. Costs are calculated using a present-worth levelized approach. There are several accounting procedures available as options including the treatment of preirradiation working capital as an add-on to the front end services cost. The code also calculates the cost of a lease cycle and can evaluate a spent fuel buyback option.
Author (NSA)

N70-19656# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Lab.
PCTR MEASUREMENT OF THE REACTIVITY EFFECTS OF 0.8% ENRICHED URANIUM FUEL IN A GRAPHITE MODERATED LATTICE WITH VARIOUS AMOUNTS OF WATER COOLANT AND FLOODING
A. D. Vaughn and M. J. Kilgore Aug. 1969 55 p refs
(Contract AT(45-1)-1830)
(BNWL-1153) Avail: CFSTI

Neutronic parameters with various water coolant and flooding conditions in a 7-1/2 inch square pitch graphite lattice containing 0.8% enriched uranium metal fuel were measured in the Physics Constants Test Reactor. The techniques and the experimental measurements necessary to derive the infinite medium neutron multiplication factor in four cases are described; namely, two different simulated flooding conditions, normal cell conditions, and the dry

cell. The neutronic parameters of an actual water flooded cell were measured and some preliminary results are derived which provide a comparison of the effects of actual water flooding with simulated flooding. All measurements were made at room temperature. Author (NSA)

N70-19657# Oak Ridge National Lab., Tenn. Chemical Technology Dept.

UNIT OPERATIONS SECTION Quarterly Progress Report, 1 Jan.-Mar. 1969

M. E. Whatley, P. A. Haas, L. E. Mc Neese, A. D. Ryon, and C. D. Watson Oct. 1969 44 p refs

(Contract W-7405-eng-26)

(ORNL-4364) Avail: CFSTI

Tests were made to evaluate flow capacities and mass-transfer efficiencies of the prototype stacked-clone contactor in a system that simulated conditions of an FBR fuel reprocessing flowsheet. Uranium processing rates as high as 41 kg/day were realized at stage efficiencies of about 50%. A close-coupled processing facility for removing fission products and fissile materials from this mixture will be an integral part of the reactor system. Experimentally determined relative volatilities indicate that adequate removal of the rare earth fluorides from fuel salt can be accomplished. The continuous fluorination of a molten salt is being studied as a means of removing uranium. Equipment is being developed for the continuous removal of UF4 from a salt stream by countercurrently contacting the salt with fluorine in a salt-phase-continuous system. Initial experiments designed to demonstrate the operability of a frozen-wall fluorinator, using a countercurrent flow of molten salt and an inert gas, were completed. NSA

N70-19662# Idaho Nuclear Corp., Idaho Falls.

CALCULATIONS OF PRESSURE-INDUCED AND THERMAL STRESSES FOR ADVANCED TEST REACTOR FUEL ELEMENTS

C. A. Moore Aug. 1969 48 p refs

(Contract AT(10-1)-1230)

(IN-1303) Avail: CFSTI

A mathematical method was developed to determine plate deflections and stresses for the ATR fuel element geometry. Maximum stresses and deflections were calculated for interior and exterior fuel plates for extreme reactor operating conditions. The maximum fuel plate azimuthal stress was calculated to be 3217 psi for the peak power element with hot spot, hot track factors applied at beginning of core life; the yield strength of the clad material is 7400 psi at this point. Axial thermal stresses were found to be slightly above the yield strength of the clad material over small regions for the same element. Since the regions of maximum axial stress occur near the side plates and since axial thermal stress is not additive to azimuthal stress, it was concluded that minor axial yielding would not limit the fuel element performance. Author (NSA)

N70-19664# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.

HYDRODYNAMIC AND THERMOKINETIC CHARACTERISTICS OF MOCK-UP SEVEN-CHANNEL FUEL RODS [HYDRODYNAMICKE A TERMOKINETICKE CHARAKTERISTIKY MAKETY SEDMITYCOVEHO PALIVOVEHO CLANKU]

R. Paryzek and M. Pasek [1969] 25 p refs In CZECHOSLOVAKIAN

(UJV-2238-R) Avail: CFSTI

The method for calculating the hydrodynamical stability of an experimental mock-up EK-7 of a seven-rod fuel element is analyzed. The step of the heating rod mock-up is s = 1.2 d. The rod diameter d = 14 mm. Two margin rods are rotating around their axis and the central one may be deflected in the direction of the connecting line of two opposite margin rods by + or - the gap between the rods. Author (NSA)

N70-19669# Atomic Energy Commission, Washington, D.C. Div. of Technical Information.

THE PEC REACTOR

Paolo Aiello et al 1969 82 p Transl. into ENGLISH from Comit. Naz. Energia Nucl. Notiziario 14 (Rome), no. 8/9, 1968 p 150-179

(AEC-tr-7084) Avail: CFSTI

Design parameters for the 140 MW(t) PEC Rast Test Reactor are presented. A review of the development program is included. Components are described and illustrated. Physics measurements are listed. NSA

N70-19670# Douglas United Nuclear, Inc., Richland, Wash. Technical Div.

REACTOR FUEL REMOVAL FOLLOWING A COOLANT FLOW STOPPAGE

H. W. Heacock and T. W. Ambrose 20 Aug. 1969 28 p Presented at the Am. Nucl. Soc. Conf. on Reactor Operating Experience, San Juan, Puerto Rico, 1-3 Oct. 1969

(Contract AT(45-1)-1857)

(DUN-SA-112; Conf-691009-1) Avail: CFSTI

Details of a coolant flow stoppage incident are presented. The recovery activities are described. Only a minimal amount of reactor outage time was caused by the incident and there were no serious radiation exposures to the personnel involved nor were there significant radiation exposures to the environs. Author (NSA)

N70-19672# Mound Lab., Miamisburg, Ohio.

SANP-27 RADIOISOTOPIC HEAT SOURCE SUMMARY REPORT

D. L. Prosser 11 Nov. 1969 8 p

(Contract AT(33-1)-Gen-53)

(MLM-1698) Avail: CFSTI

Six SNAP-27 thermoelectric generators were fabricated to provide electrical power for the Apollo Lunar Surface Experiments Package (ALSEP), a series of five experiments to be performed on the lunar surface after the SNAP-27 is transported there by the Apollo 12. Each heat source is fueled with 3735 g of plutonium-238 dioxide microspheres which will produce 1480 thermal watts of power. The SNAP-27 heat source capsule was subjected to a comprehensive series of mechanical and environmental tests to ensure the integrity of the system prior to flight authorization. Author (NSA)

N70-19675# Atomic Energy Commission, Washington, D.C. Office of Safeguards and Materials Management

SAFEGUARDS SYSTEMS ANALYSIS OF NUCLEAR FUEL CYCLES

1 Oct. 1969 312 p refs

(WASH-1140) Avail: SOD $2.25

Seven papers on safeguards systems analysis of nuclear fuel cycles are presented. The papers are on the following subjects: (1) U.S. safeguards systems analyses, (2) safeguards accountability analysis in a nuclear fuel processing plant, (3) materials balance accounting system for a chemical processing plant, (4) safeguards materials balance accounting systems in low enriched UO2 conversion and fabrication sectors of commercial fuel cycle, (5) nuclear materials management subsystem of AEC management information system, (6) statistics role in safeguards, and (7) statistical techniques for enhancing materials balance accounting in safeguards. E.C.

N70-19677# Westinghouse Electric Corp., Pittsburg, Pa. Nuclear Fuel Div.

SAXTON PLUTONIUM PROGRAM Semiannual Progress Report, Period Ending 30 Jun. 1969

W. R. Smalley Oct. 1969 118 p refs

(Contract AT(30-1)-3385)
(WCAP-3385-20) Avail: CFSTI

Progress is reviewed in an investigation of plutonium-enriched fuel in pressurized water reactor systems using a partial core of PuO2-UO2 in the Saxton reactor. Results include the following. Nuclear data from the Core 2 overpower and end-of-life experiments were reduced and evaluated. Predictions of fission gas release were made for all 118 fuel rods in the post-irradiation examination program. A sampling plan was specified for the removal of burnup, metallographic, clad hydrogen, mechanical test, and flux dosimetry specimens. Thirteen additional fuel rods were transferred to the hot laboratory, and nondestructive examinations on these rods and the five transferred earlier were completed. Final design changes in the Core 3 loose lattice fuel assemblies were made. Fuel rods for these reconstituted assemblies were removed from Core 2 assemblies, inspected, loaded into seven new loose lattice skeletons, and shipped to the Saxton reactor site. E.C.

N70-19684# Union Carbide Corp., Oak Ridge, Tenn. Oak Ridge Gaseous Diffusion Plant.
SUPPLEMENTAL RADIATION SHIELD FOR 1100-CURIE COBALT SHIPMENT
C. E. Newlon and J. C. Bailey 23 May 1969 21 p refs
(Contract W-7405-eng-26)
(K-TL-37) Avail: CFSTI

The design and shielding performance of a supplemental radiation shield which will support and contain four types of irradiated Bonus reactor control rods within a 35 ton lead-filled ATCOR cask used to transport the control rods from Puerto Rico to a disposal area in the continental U.S. are described. The supplemental shield is a disposable unit which fits inside the shipping cask and consists of a 3/4-in.-thick cylindrical steel weldment 35-1/2 in. in dia and 74 in. long, and contains an internal 2 in.-thick-steel storage box whose inside dimensions are 11-1/2 by 11-1/2 by 68-3/4 in. The maximum radiation protection provided by the ATCOR shipping cask with the new supplemental shield is approximately equivalent to that of an 8 in. thick lead shield under conditions of design loading: up to 1000 Ci of Co-60 in the 2 in. thick steel box; and up to 100 Ci of Co-60 in the annular section of the shield. It is concluded that the ATCOR shipping cask with the supplemental radiation shield appears to meet all DOT and AEC safety requirements for shipment of radioactive control rods containing 1100 Ci of Co-60. NSA

N70-19696# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
THERMAL CALCULATION OF A TUBULAR FUEL ELEMENT WITH A GIVEN RADIAL THERMAL NEUTRON FLUX [TEPELNY VYPOCET TRUBKOVEHO PALIVOVEHO CLANKU PRO DANY RADIALNI PRUBEH TOKU TEPELNYCH NEUTRONU]
M. Halouzka and P. Pecha Mar. 1969 37 p refs In CZECHOSLOVAKIAN
(UJV-2153-R) Avail: AEC Depository Libraries

A method for thermal calculation of a divided tubular fuel element has been modified in such a way that it is now possible to use any chosen radial distribution of the thermal neutron flux. It is now also possible to include some effects of the vertical division of the fuel element. The programme in "Gier-Algol" has been used to modify the geometry of a fuel-element which consists of two concentric tubes as determined by previous optimization. The purpose of the modification was to achieve equal maximum temperatures on all can-surfaces and to achieve the maximum thermal output from the fuel element. The radial distribution and spectrum of thermal neutrons have been found from the transport-equation using the first flight collision probability. Programmes previously prepared were used, and small changes in the geometry of the fuel element and reactor-cell on the neutron flux distribution were studied. Author

N70-19699# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
VANADIUM ALLOY CLADDING DEVELOPMENT Quarterly Progress Report, Period Ending 30 Jun. 1969
E. C. Bishop, R. A. Nadler, and G. A. Whitlow Aug. 1969 39 p refs
(Contract AT(30-1)-3791)
(WARD-3791-38) Avail: CFSTI

A summary of current progress is presented. Good yields of 0.500 inch OD × .050 inch wall tubing in the three VANSTAR alloys and the V-15Cr-5Ti alloy were obtained from the joint Westinghouse/ANL processing arrangement. Shipments of these materials were made. Characterization of representative samples of this tubing was completed. Sheet, 0.060 inch in thickness, was made available. Metallographic and microhardness evaluations of vanadium alloy samples exposed to sodium in both of the loop systems were completed. Loop redesign was completed and reconstruction of the system is underway. Eight additional carbide fueled irradiation pins, each containing one vanadium alloy tensile/creep sample, were assembled. Author (NSA)

N70-19700# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PERT-5: A TWO-DIMENSIONAL PERTURBATION CODE FOR FAST REACTOR ANALYSIS
R. W. Hardie and W. W. Little, Jr. Sep. 1969 97 p refs
(Contract AT(45-1)-1830)
(BNWL-1162) Avail: CFSTI

PERT-V is a two-dimensional perturbation theory code for use in fast reactor analysis. The code will: compute reactivity coefficient traverses using first order perturbation theory; compute the effective delayed neutron fraction, the neutron generation time, and the inhour/sigma k conversion factor; and compute activity traverses. The code was written to be compatible with the BNW one and two-dimensional diffusion theory codes 1DX and 2DB, and the Los Alamos one- and two-dimensional transport theory codes DTFIV and 2DF. All five codes use the same input module. PERT-V is written entirely in FORTRAN-IV. Variable dimensioning is utilized to make maximum use of available core storage. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N70-18314# North Carolina State Univ., Raleigh.
DIFFRACTION OF LIGHT BY A GRATING SUBJECTED TO HOMOGENEOUS STRAINS AND RIGID BODY ROTATIONS
H. W. Blake, H. H. Stadelmaier, and R. A. Douglas Oct. 1969 246 p refs
(Contract N00014-68-A-0187; ARPA Order-1090
(AD-696558; TR-69-8) Avail: CFSTI CSCL 20/11

A general diffraction-strain theory is developed for the optical diffraction grating strain gages now being used to measure large dynamic strains in solids. General diffraction-strain equations are derived that relate the surface strains to observable changes in a diffraction pattern. Using the Laue diffraction theory, diffraction-strain equations for crossed grating strain gages are derived. Since the current use of the diffraction grating strain gage is to detect plastic strains produced by the axial impact of cylindrical rods, attention is devoted to the development of specific equations and optical configurations for experiments of this type. Several optical configurations for measuring either the axial or the circumferential strain component of the rod are proposed. Author (TAB)

N70-18399# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
HYSTERESIS OF DYNAMIC SPLITTING UP INTO DOMAINS IN THIN FERROMAGNETIC FILMS
Hartmut Hoeger et al Apr. 1969 28 p refs Transl. into ENGLISH from East Ger. Publ. Sponsored by MIT, Lincoln Lab. (Rept-158-69-355-GELL) Avail: CFSTI

After applying a fast hard-axis pulse field instead of a dc field to a thin magnetic film, no splitting up into domains occurs. To obtain the demagnetized state a small field Delta H in the opposite easy axis must be applied simultaneously. It was found that the magnitude of this hysteresis field H decreases with increasing pulse field strength and width, but increases with the angular dispersion of the film. This is caused by nonlinear magnetostatic fields effecting magnetization blocking for high angular dispersion films. Author

N70-18414# LTV Research Center, Anaheim, Calif.
POINT-TO-POINT CORRELATION OF SOUND PRESSURES IN REVERBERATION CHAMBERS
Charles T. Morrow *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 87–97 refs (See N70-18404 07-32)
Avail: CFSTI

The response of a structure to a noise field depends in part on the point-to-point correlation of the field. A diffuse sound field with correlation distances comparable to the separation between structural antinodes tends to excite all modes of vibration. A highly correlated field, such as that of low-frequency rocket noise, tends to produce relatively selective modal responses and somewhat reduced overall rms level. At the other extreme very short correlation distances tend to decrease the response without making it selective. High-intensity noise tests are generally intended to simulate rocket noise and/or aerodynamic turbulence about a space vehicle, both of which excite vibration modes somewhat selectively according to the portion of the trajectory considered. The best test policy may well be to use the reverberant field to simulate a composite flight condition and apply correction factors judiciously to the sound pressure level. In any event, the point-to-point narrow-band correlation of the reverberant field should follow closely some simple formula. Author

N70-18426# Lamont Geological Observatory, Palisades, N.Y.
INVESTIGATION OF ACOUSTICAL PROPERTIES OF THE SEA FLOOR RELEVANT TO LONG-RANGE SONAR PERFORMANCE IN THE OCEANS OF THE WORLD Final Report, 1 Oct. 1960-30 Sep. 1968
George M. Bryan Oct. 1969 16 p refs
(Contract NOBSR-85077)
(AD-696142) Avail: CFSTI CSCL 17/1

The principal aim of the research was the investigation of acoustical properties of the sea floor relevant to long-range sonar performance in the oceans of the world. In many situations involving long-range sonar it is necessary to depend on the bottom-reflected path. The topographic relief of the water sediment interface itself, based on precision echo sounding; and the material properties of the first few meters of sediment, by means of deep-sea coring. Author (TAB)

N70-18514# Texas Univ., Austin. Applied Research Labs.
ACOUSTIC MODELING, SIMULATION, AND ANALYSIS OF COMPLEX UNDERWATER TARGETS. 2: STATISTICAL EVALUATION OF EXPERIMENTAL DATA
David Middleton 26 Jun. 1969 67 p refs
(Contracts N00024-69-C-1129; Nonr-4833(00))
(AD-696596; ARL-TR-69-22) Avail: CFSTI CSCL 17/1

Some methods of analyzing experimental data for complex targets and reverberation are outlined, including a heuristic discussion of what constitutes an ensemble and how to obtain one experimentally. The problem of then determining whether or not the actual data form a valid ensemble is considered. Tests for the stability, or stationarity, of the underlying random mechanism are briefly described (test of independence and homogeneity); tests of whether or not a particular data set belongs to some postulated probability distribution are provided (goodness-of-fit), including a powerful test for establishing the normality or non-normality of the sample. Among the tests considered are the X squared, the Kolmogorov-Smirnov, the runs test, and the W-test for normality. These tests are carried out for some hypothetical reverberation data to illustrate the individual tests, at particular ranges, which can include the domain of a target reverberation. Some second-order properties of various classes of second moments of these data are also discussed, and an approach to relating simulated data to those from a real environment is briefly sketched. This memorandum is intended as a preliminary guide to the statistical treatment of data that are obtained in target and background measurements. Author (TAB)

N70-18523# Wayne State Univ., Detroit, Mich. Dept. of Chemistry.
EXPERIMENTAL INVESTIGATIONS ON THE LIGHT SCATTERING OF COLLOIDAL SPHERES. 8. DETERMINATION OF THE ANGULAR VARIATION OF LIGHT SCATTERING BY MEANS OF A NEW TYPE OF REFLECTIONFREE SCATTERING CELL
Wilfried Heller and Jack Witeczek 10 Nov. 1969 25 p refs
(Contract Nonr-3511(00))
(AD-697314; TR-20(66)) Avail: CFSTI CSCL 14/2

The various problems arising in measurements of the angular variation of dissymmetric light scattering by means of conventional scattering cells are reviewed, including several problems to which only scant attention had been paid previously. Above all, a new type of scattering cell, provided with both a terminal Rayleigh horn and a Wide Angle Horn is described which eliminates all complications due to reflections of primary and scattered beams. Results obtained with the new cell agree very well with the theoretical data calculated for the scattering system used, a monodisperse Dow latex. The results are also compared with those obtained with a conventional scattering cell after correcting the data, in the latter instance, by means of an improved version of the Kratohvil correction equation. Author (TAB)

N70-18538# Signals Research and Development Establishment, Christchurch (England).
LIMITATIONS IN OPTICAL IMAGING DEVICES AT LOW LIGHT-LEVELS
E. A. Richards Jan. 1969 26 p refs
(AD-697169; SRDE-69010) Avail: CFSTI CSCL 17/8

An examination is made of the influence of objective lens parameters on the resolution capabilities of low light-level imaging devices. From the resulting characteristics the dependence of the perception range of a given target on the incident light-level is deduced. The restrictions imposed by larger lenses on the depth-of-field of acceptable focus are investigated, and comparisons made with the thresholds set by quantum-noise and optical resolution limitations. Degradations in the performance of image-intensifiers due to different levels of image-tube darknoise are also discussed. Author (TAB)

N70-18562# Ion Physics Corp., Burlington, Mass.
HIGH VOLTAGE BREAKDOWN STUDY Quarterly Progress Report, 16 Feb.-15 May 1969
W. R. Bell, P. C. Bolin, M. J. Mulcahy, and F. Y. Tse Oct. 1969 57 p refs
(Contract DA-28-043-AMC-00394(E)); ARPA Order-517)
(AD-697156; ECOM-00394-16; QPR-16) Avail: CFSTI CSCL 20/3

Current results of an energy conditioning study are reported in which the energy and current available to a discharge was varied over a wide range for different electrode materials and sizes. It was

found that many high energy discharges (5000 J) can be endured without permanent damage, that high impedance conditioning is helpful in quickly reaching high breakdown voltage levels, that crowbarring within 500 ns is partially but not totally effective in limiting damage due to high energy discharges and that a series resistance of 5 kilohms is required to limit the damage due to high energy discharges to a negligible level. Initial design of the next phase of the experimental program, a barium contamination and energy conditioning study is discussed. Author (TAB)

N70-18731*# National Aeronautics and Space Administration, Washington, D.C.
CRYOGENIC AND SUPERCONDUCTING MAGNETS
James C. Laurence, Gerald V.Brown, Willard D. Coles, and Gale Fair *In its* Plasmas and Magnetic Fields in Propulsion and Power Res.
Avail: CFSTI CSCL 20C

Research in advanced concepts of power generation and propulsion is discussed. The advantages of low-impedance, high current design for producing intense large volume magnetic fields are considered to be: (1) The magnet windings are made in large cross sections to take advantage of the very heavy currents, and the conductors are nearly self-supporting because of their size. (2) Since the potential difference between turns is small, no high voltage insulation or water treatment is required. (3) Cryogenic cooling of the conductors to reduce resistance can be used. Also included are discussions of cryogenic magnets, aluminum magnet construction, current work on cryogenic magnets, superconducting magnets, and stabilized superconductors. F.O.S.

N70-18747# City Coll. Research Foundation, New York.
ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS Final Report, 1 Nov. 1966-30 Jun. 1969
Lorenzo Abella and Morris Ettenberg Fort Monmouth, N.J. ECOM Sep. 1969 57 p refs
(Contract DAAB07-67-C-0159)
(AD-697187; ECOM-0159-F) Avail: CFSTI CSCL 20/3

The theory of electrostatic focusing of hollow spiraling electron beams is reviewed. The experiment on an end fire injection scheme is described and experimental measurements are presented. The trajectory calculation program is described and a typical computer run is presented. Author (TAB)

N70-18749# Houston Univ., Tex. Dept. of Mechanical Engineering
SINUSOIDAL HORNS
B. N. Nagarkar and R. D. Finch Aug. 1969 62 p refs
(Contract Nonr-4492(01))
(AD-697285; TR-19) Avail: CFSTI CSCL 20/1

It is shown theoretically that the sinusoid satisfies Salmons criteria for a good horn shape. It is also shown theoretically that a sinusoidal horn will effect impedance transformation and experimentally that it enhances the directivity of an underwater transducer. It is observed that such horns have been in use for a long time in certain musical instruments, such as the English horn, and an explanation is given of its function in the instrument. Author (TAB)

N70-19043# Washington High School, Washington, Penn.
OBSERVATIONS OF THE FISSION OF CHARGED DROPLETS
Michael Kearney *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 222-236 refs Presented at Penn. Junior Sci. and Humanities Symp., University Park, Penn., 4 Nov. 1968 (See N70-19027 07-02)
Avail: CFSTI

Solutions of distilled water, tap water, a normal NaCl solution, and a detergent solution were tested for the effects of static electricity on fission of droplets. The ratio of large to small droplets formed by the splitting of a single droplet varied according to the test solution used. As the surface tension of a droplet decreases, the probability that an unequal size ratio will occur in the fission becomes greater, since surface tension appears to be the primary factor controlling the size ratio distribution. A proposal is made to extend the test results to charged droplets in air with possible application toward understanding weather conditions. R.B.

N70-19092 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATING THE LIGHT FLUX DISTRIBUTION FROM A LINEAR SOURCE
M. M. Epaneshnikov et al Sep. 1969 7 p refs Transl. into ENGLISH from Svetotekhnika (Moscow), No. 4, p 6-8
(NLL-RTS-5291) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 1 NLL photocopy coupons

A procedure to theoretically determine the light flux incident on the nominal surface is presented. The approach taken is to divide the space around the line of light into equal sectors of included angle. Solution is accomplished by calculation of: (1) the relative length of the line of lamps, (2) the k values for 10-degree angular zones, (3) the flux in each angular zone, and (4) the final determination of the flux incident on the nominal surface. D.L.G.

N70-19127 Yale Univ., New Haven, Conn.
ADAPTIVE SONAR SIGNAL DESIGN
Francis Sherburne Hill, Jr. (Ph.D. Thesis) 1968 206 p
Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 69-8609

The problem of designing sonar signal waveforms, or 'pings,' to locate a submarine target is considered. It is assumed that a single target is present, and that the observer has measured its angular bearing and bearing rate by means of passive sonar equipment. The active sonar is used to measure the target's range and range rate The target is assumed to be moving on a fixed course with constant speed. The optimal single ping estimation of target parameters in colored gaussian noise is considered using a maximum inverse probability philosophy. The ambiguity problem is analyzed, and for the case of large signal-to-noise ratio, the optimal estimator is evaluated in terms of the signal and noise spectra. The pronounced effect of target range rate on the estimation accuracies in the colored noise case is discussed. Dissert. Abstr.

N70-19130# Temple Univ., Philadelphia, Pa. Physics Dept.
SPACE TIME CORRELATIONS IN EXCHANGE COUPLED PARAMAGNETS AT ELEVATED TEMPERATURES
Raza A. Tahir-Kheli and Daniel G. Mc Fadden 1969 48 p refs Sponsored in part by NSF
(Contract N00014-68-A-0264)
Avail: CFSTI CSCL 20/12

The phenomenological two-parameter Gaussian construction for the generalized diffusivity seems to be an adequate approximation for calculating the dynamic properties of Heisenberg spin systems at elevated temperatures. It is felt therefore that the present calculations are a meaningful first estimate of the structure of the space-time dependent correlation functions. Author (TAB)

N70-19172# Columbia Univ., New York. Dept. of Physics.
PULSAR TEST OF A VARIATION OF THE SPEED OF LIGHT WITH FREQUENCY
G. Feinberg [1969] 8 p refs Sponsored in part by AEC
(NYO-1932(2)-152) Avail: CFSTI

The sharply defined optical and radio pulses from pulsars allow a test of the variation of the speed of light with frequency, and of the possible existence of a photon mass. The data indicates that real photons have a mass less than 5×10 to the minus 45th power g. Detection of extragalactic pulsars could allow a substantial improvement of this limit. Author (NSA)

N70-19173*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A DIGITAL TECHNIQUE FOR DETERMINING 1/3 OCTAVE SOUND-PRESSURE LEVELS WITH A MORE UNIFORM

CONFIDENCE LEVEL
John W. Shipley and Ronald A. Slusser 1 Jul. 1969 7 p refs
(Contract NAS7-100)
(NASA-CR-108211; JPL-TM-33-422) Avail: CFSTI CSCL 20A

A computer program written to analyze acoustical test data is described. The program employs a fast Fourier subroutine to calculate the discrete Fourier coefficients that transform the time-domain data to frequency-domain data. To achieve a more equal confidence level between the upper and lower 1/3 octaves, the digital data record is sampled at a high rate, and the fast Fourier coefficients are calculated. The same digital data record is then sampled at a much lower rate to provide greater low-frequency resolution for the lower 1/3 octaves. Digital windowing techniques are considered, and their effect on spectral representation is compared with that of analogous analysis methods. Author

N70-19208 Kent State Univ., Ohio.
INTERACTION OF FORWARD AND BACKWARD MASKING BY NARROW BAND NOISE
Jerry Lewis Homick (Ph.D. Thesis) 1968 65 p
Avail: Univ. Microfilms: HC $3.60/Microfilm $3.00 Order No. 69-9557

The interaction of forward and backward auditory masking is investigated to determine the nature of the additive processes that occur in the auditory system when conditions of equally effective forward and backward masking are combined. Two experiments were conducted in order to accomplish this purpose. Experiment 1 investigated independently forward and backward masking of a 12 msec tonal signal by a 250 msec narrow-band noise burst. Forward and backward masked thresholds were determined for each combination of variables by varying the duration of masking interval. Experiment 2 investigates the interaction or additivity of forward and backward masking by taking the difference between the intensity of the signal at masked threshold in Experiment 2 and the intensity of that signal in Experiment 1. Dissert. Abstr.

N70-19209 Syracuse Univ., N.Y.
WAVE PROPAGATION IN MOVING ANISOTROPIC MEDIA
Jin-au Kong (Ph.D. Thesis) 1968 135 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 69-7752

A bianisotropic medium is defined as one in which the field vectors D and H depend upon both E and B but may not be parallel to either. General transformation formulas for the constitutive relations of a bianisotropic medium between inertial frames in relative motions are given. It is shown that, for time-harmonic fields, a bianisotropic medium can be viewed as one which is both electrically and magnetically anisotropic with properly defined dyadic operators. In particular, a moving medium can be characterized by a permittivity tensor and a permeability tensor for plane wave propagation. The dispersion relations in a bianisotropic medium are obtained. Governing equations for guided waves are derived and solved in a moving gyroelectrically anisotropic medium. Dissert. Abstr.

N70-19220# Dow Chemical Co., Golden, Colo. Rocky Flats Div.
A FORTRAN 4 PROGRAM FOR ELLIPSOMETER MEASUREMENTS OF SURFACE FILMS
Robert W. Loser and Donald T. Larson 17 Oct. 1969 36 p refs
(Contract AT(29-1)-1106)
(RFP-1392) Avail: CFSTI

A FORTRAN 4 program is presented for use with an ellipsometer to determine the index of refraction of a surface film, the thicknesses of the surface film and the index of refraction of the substrate materials. The program processes data taken by an ellipsometer which is used to measure the growth of a surface film. The ellipsometer measurements are described as input data, and refractive index and film thicknesses are described as output data. Included is a brief description of the techniques used to determine refractive index and surface film thicknesses, and a complete description of the FORTRAN 4 program. Author (NSA)

N70-19247 Cornell Univ., Ithaca, N.Y.
KINETIC DISRUPTION OF OPTICAL TEXTURE: THE PERCEPTION OF DEPTH AT AN EDGE
George A. Kaplan (Ph.D. Thesis) 1968 130 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 69-8849

An analysis of the changes in proximal stimulation which result from changes in the occlusion of one surface by another has led to the definition of a kind of optical transition which is called *optical accretion/deletion*. Given this transition or transformation, two hypotheses are developed which predict the perceived direction of depth at an occluding edge. The analysis is in the absence of any traditional cues for preception of relative depth. Dissert. Abstr.

N70-19293 Iowa Univ., Iowa City.
ON PARAMETRIC ARRAY RECEPTION, WITH APPLICATION TO OCEAN ACOUSTIC SIGNALING
David Walter Hyde (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-8750

In the analysis and synthesis of communication and detection systems for underwater acoustic applications, the emphasis in past work has been placed on the use of discrete arrays of point transducers for efficient reception. However, the influence of the stochastic properties of long ocean acoustic paths has not been considered in these studies. The parametric, or optimum, array detection problem is considered for the general case of a random time-varying channel and binary signals in the specific instances where: 1) The signal processing is discrete and the channel and the additive noise field in the medium are both Gaussian; 2) The signal processing is continuous and the channel and noise are both Gaussian; 3) The channel and noise are non-Gaussian but have governing distributions, which belong to a certain class of distributions. Dissert. Abstr.

N70-19311 Virginia Univ., Charlottesville.
ELECTROMAGNETIC TRANSMISSION THROUGH THIN FILMS IN LOSSY RECTANGULAR WAVEGUIDE
Walton Jackson Kitchen (Ph.D. Thesis) 1968 94 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 68-18215

The EM power transmission coefficients of thin films placed in the transverse plane of a rectangular waveguide are shown to be singularly dependent upon the product of thin film conductivity times film thickness. An error analysis justifies the simplification of the theoretical expression for the power transmission coefficient. Excellent agreement is obtained with experimental data taken from metal, semimetal, and semiconductor films. A perturbation scheme is used to derive expressions for the field components in lossy rectangular waveguide. From these an attenuation constant for the dominant TE(10) mode is developed. Dissert. Abstr.

N70-19407# Temple Univ., Philadelphia, Pa. Physics Dept.
SPACE-TIME DEPENDENT CORRELATION FUNCTIONS FOR ONE-DIMENSIONAL HEISENBERG SPIN SYSTEM IN A LORENTZIAN-GAUSSIAN APPROXIMATION
Daniel G. Mc Fadden, Raza A. Tahir-Kheli, and G. Bruce Taggart [1969] 25 p refs Sponsored in part by NSF
(Contract N00014-68-0264)
(AD-696565) Avail: CFSTI CSCL 20/12

Comments are given concerning the recent work of Fernandez and Gersch on the frequency Fourier transform of the self-correlation function for a one-e. The frequency Fourier transform of the self-correlation was computed as well as those for several spatially

separated correlations. The results are in good agreement with those calculated by Carboni and Richards from an AB-INITIO, exact procedure. TAB

N70-19529# Idaho Nuclear Corp., Idaho Falls.
POLAROGRAPHIC KINETIC CURRENTS FOR THE FIRST-ORDER, ONE-HALF REGENERATION MECHANISM AT SPHERICAL ELECTRODES
J. R. Delmastro and G. L. Booman Sep. 1969 11 p refs
(Contract AT(10-1)-1230)
(IN-1274) Avail: CFSTI

The analytical solution for the large potential-step electrode response at a stationary spherical electrode with the first order, one half regeneration mechanism was derived by a nonroutine application of the Laplace transformation method. The form of the resulting solution depends on the value of the effective electrode sphericity. Author (NSA)

N70-19596# Argonne National Lab., Ill. Metallurgy Div.
USE OF THE CONDUCTING MASK IN PULSED ELECTROMAGNETIC TESTING
C. W. Cox (N. Dak. School of Mines and Technol.) and C. J. Renken Apr. 1969 34 p refs
(Contract W-31-109-eng-38)
(ANL-7172) Avail: CFSTI

The application of conducting masks to the problem of nondestructive testing by means of pulsed electromagnetic fields was studied. The diffusion of a pulsed plane wave into a semi-infinite conductor was calculated, and formulas were derived for pulse attenuation and delay, as well as for field strength inside and outside the conductor. The plane-wave assumptions cause serious discrepancies between calculated and experimentally measured fields through conducting sheets. A qualitative analysis of the symmetrical mask offers a satisfactory explanation for most of the experimentally observed features of its operation, and provides an insight into the operation of other types of masks. Author (NSA)

N70-19617# Addis Translation International, Woodside, Calif.
DESIGN AND CALCULATION OF MAGNETIC-DISCHARGE PUMPS
M. D. Malev and E. M. Trakhtenberg Oct. 1969 30 p refs
Transl. into ENGLISH from a Russian Report, (USSR), 1969 Prepared for Stanford Linear Accelerator Center
(SLAC-Trans-101) Avail: CFSTI

The operating principle and functional characteristics of a magnetic-discharge pump are described. On the basis of previously obtained empirical formulas for the evacuation rate and minimum pump pressure, a method is proposed for calculating the basic dimensions of a magnetic-discharge pump for given values of the evacuation rate, working pressure and magnetic-field strength. The influence of the required residual-atmosphere composition and range of working pressures on the design of the basic pump elements was studied, and some practical recommendations for designing built-in magnetic-dishcarge pumps are given. Author (NSA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N70-18380# Michigan Univ., Ann Arbor. Dept. of Physics.
PROTON-PROTON INTERACTIONS ABOVE 100 GeV
L. W. Jones, A. E. Bussian, G. D. DeMeester, B. Loo, D. E. Lyon et al Sep. 1969 15 p Presented at the 11th Intern. Conf. on Cosmic Rays, Budapest, Aug. 1969
(Grant NSF GP-13265)
(Rept-03028-2-T) Avail: Issuing Activity

In an experiment at Echo Lake, Colorado a detector consisting of an ionization calorimeter, spark changes, and a 2000 liter liquid hydrogen target was operated to collect over 100,000 triggers corresponding to greater than 80 GeV calorimeter events. Quantities studied include multiplicities, angular distributions, and total inelastic cross sections. Preliminary results give an average multiplicity of secondaries from hydrogen interactions of hadrons about 70% of that from carbon interactions in the 100-400 GeV energy range. Author

N70-18381*# University of Southern Calif, Los Angeles. Dept. of Physics.
FLUORESCENCE SPECTRA RESULTING FROM VUV PHOTON IMPACT ON COS
D. L. Judge and M. Ogawa 1 Oct. 1969 12 p refs
(Grant NGL-05-018-044; Contract Nonr-228(27))
(NASA-CR-107934; AD-694898; USC-vacuv-117) Avail: CFSTI CSCL07E

The COS(+) A doublet Pi - X doublet Pi emission bands between 3500 and 6500 A have been observed following vacuum ultraviolet photon impact on COS. Only the V' = 0 progression is found to occur for incident vacuum ultraviolet photons in the energy range 15.11 to 20.3 eV. Author (TAB)

N70-18392# National Bureau of Standards, Washington, D.C. Nuclear Radiation Div.
USE OF AN ON-TIME COMPUTER IN NEUTRON TIME-OF-FLIGHT MEASUREMENTS
H. T. Heaton, II Jan. 1970 32 p refs
(NBS-TN-515) Avail: SOD $0.35

The versatility of an on-line computer for doing nuclear physics research by giving a detailed explanation of how the neutron time of flight experiments use such a system. The main features of the SDS 920 computer used on-line are given. The use of the interrupt capability for gathering data from experimental equipment was described. Board programs and their initiation throughout the program selector board are described as one method of manipulating the information in the data fields of interrupt or board programs. The experimental agreement in conjunction with the linear accelerator is described including a description of what signals the experimental apparatus supplied to the computer and how the computer was able to use information to determine if the monitors were within preset limits and if not to automatically terminate the run. By having the computer monitor the experimental conditions, the experimenter is relieved of much of the routine data gathering and thereby allowed to concentrate on the experiment itself. Author

N70-18489# Battelle-Northwest, Richland, Wash.
FAST REACTOR DOSIMETRY AND DAMAGE ANALYSIS: EBR-2 DOSIMETRY TEST
R. E. Nightingale, J. L. Jackson, W. N. Mc Elroy, J. A. Ulseth, L. S. Kellogg et al *In its* Reactor Fuels and Mater. Develop. Programs for Fuels and Mater. Branch of USAEC Div. of Reactor Develop. and Technol. Aug. 1969 p 11.1-11.24 refs (See N70-18484 07-22)
Avail: CFSTI

Reaction rate ratios can be used to identify changes in neutron spectra since monitors respond differently to neutrons of different energies. Data from the recent EBR-II dosimetry test show a possible change in the spectrum between the low- and high-power tests. Other data from the high-power tests show the spectrum was constant axially in Row 2 up to 4 in. above midplane. Such information on spectra is useful in the analysis of both monitor and irradiation damage data. A set of group-averaged values of the damage function was selected and used to compare measured and damage-function calculated fluences for new experimental Delta TT data. The results provide further validation of the applicability of the damage function. Recent indications of a significant contribution by thermal neutrons to the embrittlement of some ferritic steels have prompted computer experiments on low-energy displacement spikes such as produced by recoils. Author (NSA)

N70-18591# Oklahoma Univ., Research Inst., Norman.
THEORETICAL CALCULATIONS CONCERNING BETA DECAY Final Technical Report, 1 Sep. 1967-31 Aug. 1969
James N. Huffaker Sep. 1969 41 p refs
(Grant DA-ARO(D)-31-124-G950)
(AD-697166; AROD-7588-1-P) Avail: CFSTI CSCL 20/8

A calculation of allowed but very-much-hindered beta-decay spectra was completed and applied to the beta transition from 14O to the 14N ground state. This calculation permits the use of the experimentally-obtained spectral shape as a criterion for evaluating the various nuclear models. A class of such models is described which reproduces the observed ft value and shape of the 14O decay. A discussion is presented of other transitions within the mass-14 system and of ambiguities in determining the Gamow-Teller allowed matrix element. A computer program was prepared to calculate exact electron radial functions treating the nucleus as a uniformly-charged sphere. In particular, the program avoids the phase-error of earlier calculations, and permits averaging over the nuclear volume. A comparison with previously-reported analytic approximation is given. Author (TAB)

N70-18600# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
NUMERICAL SOLUTION OF THE TWO-DIMENSIONAL TIME-DEPENDENT MULTIGROUP EQUATIONS
W. T. Mc Cormick, Jr. and K. F. Hansen *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 76-101 refs (See N70-18594 07-22)
(Contract AT(30-1)-3903)
Avail: CFSTI

A numerical algorithm for the solution of the two dimensional time dependent multigroup neutron diffusion equations is presented. The method assumes that the variation in the neutron flux at each mesh point can be represented as an exponential function of time over each integration time step. Additionally, the assumption is made that the transverse leakage in one spatial direction can be approximated by a pointwise transverse buckling over one time step. these assumptions together with an appropriate factoring and integration of the matrix form of the semi-discrete multigroup equations produce a mathematically consistent approximation and an unconditionally stable algorithm. It is also shown, for the special case of a constant step change in reactor properties, that the asymptotic numerical solution is proportional to the asymptotic eigensolution of the semi-discrete multigroup equations. The experimentally observed truncation error is discussed and several numerical experiments are presented which illustrate the accuracy and utility of the method. R.B.

N70-18604# European Atomic Energy Community, Geel (Belgium). Central Bureau for Nuclear Measurements.
USE OF A PROCESS CONTROL COMPUTER SYSTEM IN ANALYSIS OF NEUTRON CROSS SECTION DATA AND THE CONTROL OF NEUTRON DATA ACQUISITION FACILITIES AROUND A VAN DE GRAAFF AND AN ELECTRON LINERAR ACCELERATOR
H. Horstmann, A. De Keyser, and H. Schmid *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 143-154 refs (See N70-18594 07-22)
Avail: CFSTI

A description of an IBM 800 computer-based data processing system for neutron cross section measurements at 90 MeV electron linear accelerator and a 3 MeV Van de Graaff accelerator is given. The data acquisition system includes an IBM 729/IV magnetic tape unit. Both on-line and off-line data processing are described. NSA

N70-18612# General Electric Co., Schenectady, N.Y. Knolls Atomic Power Lab.
VARIATIONAL METHODS AND NEUTRON FLUX SYNTHESIS
E. L. Wachspress *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 271-296 refs (See N70-18594 07-22)
Avail: CFSTI

Synthesis techniques for computing neutron fluxes in a reactor are reviewed. Specifically the construction of approximations in n dimensions using known base functions of r dimensions where r is less than n is investigated. Variational methods are discussed and an example of their use in neutron diffusion computations of the thermal spectrum problem is included. An alternative variational principle is the use of discontinuous trial functions which is recommended for broadening the scope of synthesis computations. M.H.E.

N70-18620# Oak Ridge National Lab., Tenn.
NUCLEAR MODEL PROGRAMMING FOR DATA GENERATION
K. J. Yost *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 493-499 refs (See N70-18594 07-22)
Avail: CFSTI

Reliable data on nuclear energy levels are necessary in problems concerning secondary gamma-ray production cross sections as employed in shielding and gamma heating calculations. A nuclear model code used in a system for calculating gamma-ray production cross sections is presented. The code generates the solution of the Schroedinger equation for a single particle in a deformed potential well within the nuclear core subject to collective excitations. As an example, the energy levels of U-239 were calculated by the code. NSA

N70-18633# North American Rockwell Corp., Downey, Calif. Atomics International Div.
A NEW NON-MULTIGROUP ADJOINT MONTE CARLO TECHNIQUE
Leo B. Levitt and Jerome Spanier *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 633-649 refs (See N70-18594 07-22)
(Contract AT(04-3)-701)
Avail: CFSTI

An adjoint technique which appears to be very useful for solving problems in the slowing-down region below the threshold for inelastic scattering is described. The physically intuitive basis for this technique is by means of an exact reversal of direct Monte Carlo random walks, including the preservation of scattering angles. It is shown that this reversal may be also accomplished by a transformation of the adjoint transport equation by means of a discontinuous importance function which, in each region of the problem, is the flux in an infinite medium of scatterer appropriate for that region. From the latter point of view this transformation may be seen to be a logical extension of continuous energies of the adjoint multigroup formulation of Spanier and Gelbard. The new technique considerably expands the range of problems tractable by Monte Carlo. It seems particularly well-suited, for example, to the analysis of foil experiments and computational times appear to be sufficiently low to permit parametric studies to be performed cheaply. Author (NSA)

N70-18635# International Business Machines Corp., Palo Alto, Calif.
AN EXPERIMENTAL MONTE CARLO PROGRAM FOR THREE DIMENSIONAL NUCLEAR SYSTEMS
Charles S. Shapiro *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 659-675 refs (See N70-18594 07-22)
Avail: CFSTI

The feasibility of using the Monte Carlo technique for solving large three-dimensional reactor problems is evaluated. Methods for analysis and physical assumptions necessary for solution to the neutron transport theory equations are outlined. The resultant program is described; a flow diagram is included. The types of

problems that the program handles are described. Results of the application of the program to the calculation for the fission source distribution of a ZPR-3 fast reactor are given. NSA

N70-18650# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
COMPILATION OF LOW ENERGY COLLISION CROSS SECTION DATA. PART 2: LINE AND LEVEL EXCITATION
L. J. Kieffer 22 Sep. 1969 176 p refs Sponsored in part by NBS
(Contract DA-31-124-ARO(D)-139)
(AD-696467; JILA-7) Avail: CFSTI CSCL 7/4

The document is the second part of a comprehensive compilation of low energy electron collision cross section data. The compilation is limited to experimental measurements and includes data for all atomic species and those molecules which are important for aeronomy, astrophysics, and plasma physics. TAB

N70-18662# Boston Univ., Mass.
PHOTON AND ELECTRON EXCITATION OF NUCLEAR ISOMERS Final Report, 1 Jun. 1965-1 Jun. 1969
Edward C. Booth 1 Jun. 1969 7 p
(Grants DA-ARO(D)-31-124-G710; DA-ARO(D)-31-124-G899)
(AD-697153; AROD-5626-4-P) Avail: CFSTI CSCL 20/8

Isomeric states of stable nuclei have been excited by photons and electrons via short-lived higher states. The isomer excitation experiments were undertaken in order to determine the relationship between the total inelastic electron scattering cross section and the radiative width, and to use the isomer excitation function to determine the energies widths, and angular momenta of accessible states. The following isotopes were studied: strontium-87, rhodium-103, cadmium-111, indium-113, indium-115, tin-117, barium-135, barium-137, platinum-195, and mercury-199. TAB

N70-18851*# Oak Ridge National Lab., Tenn. Neutron Physics Div.
TABULATED CROSS SECTIONS FOR HYDROGEN AND HELIUM PARTICLES PRODUCED BY 62- AND 29-MeV PROTONS ON AU-197
F. E. Bertrand (Univ. of Southern Calif.) and R. W. Peelle Dec. 1969 44 p refs
(NASA Orders L-12186; R-104(1); Contract W-7405-eng-26)
(NASA-CR-108123; ORNL-4460) Avail: CFSTI CSCL 20H

Tabulated differential cross sections are presented for the production spectra of proton, deuteron, triton, helium-3, and alpha particles from Au-197 bombarded by approximately 62- and 29-MeV protons. Continuum cross sections are given at 6 angles from 15 through 125 degrees, over the energy region down to a low-energy cutoff of 3 to 13 MeV which depends on particle type. Author

N70-18877# Case Western Reserve Univ., Cleveland, Ohio.
DISSOCIATION ENERGIES OF NEW MOLECULES OF THE NITROGEN FAMILY
Fref John Kohl (Ph.D. Thesis) 1968 229 p
Avail: Univ. Microfilms: HC $10.35/Microfilm $3.00 Order No. 69-9414

The experiments are based on molecular beam sampling by mass spectrometry of vapors in equilibrium with their condensed phases. Studies of the vaporization of Bi, As-P, Sb-As, Bi-As, Bi-Sb, and Bi-Sb-As establish the existence of the following new molecules: Bi3, Bi4; Bi3Sb, Bi3As, Bi2Sb2, Bi2AS2, Bi2SbAs, BiSb2As, BiSbAS2, BiSb3, BiAS3, Sb3As, Sb2AS2, SbAS3; and BiSb, BiAS, SbAS. The following atomization energies have been measured: Bi3, Bi4, Bi3Sb, Bi2Sb2, BiSb3 and BiSB. In addition, a new theory has been devised to measure cross sections for electron impact fragmentation. Intercombinations of atoms of this family form complete classes of molecules having similar bond types with systematically varying stabilities. Dissert. Abstr.

N70-18882 Californi Univ., Berkeley.
COLLISIONAL ENERGY TRANSFER IN MONOCHROMATICALLY EXCITED HD
Daniel Lee Akins (Ph.D. Thesis) 1968 233 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.05 Order No. 69-10241

The HD molecules were excited by absorption of Ar(1066 A) resonance radiation, to the v' = 3, J' = 2 vibration-rotation level of the excited electronic state. Transfer rate constants and cross sections were measured for collisionally induced rotational, vibrational, and electronic energy transfer between the monochromatically excited HD molecules and rare gases. Collisional transfer of rotational energy does not obey the optical selection rule Delta J = + or - 1, rather Delta J = + or - 2 is favored with Delta J = + or - 1, and +3 also occurring. Dissert. Abstr.

N70-18964# Atomic Weapons Research Establishment, Aldermaston (England).
THE DEVELOPMENT OF ACCELERATOR NEUTRON SOURCES FOR FAST REACTOR PHYSICS EXPERIMENTS
J. Gray, M. L. Mullender, and D. L. E. Smith Nov. 1969 57 p refs
(AWRE-0-50/69) Avail: HMSO 10s; BIS $2.00

Two low-energy high-current deuteron accelerators used as neutron sources for fast reactor physics experiments are described and the development work which has been done on their pulsing systems and the operational problems related to their use in the fast reactor physics program are discussed. The pulsed source requirements for time-dependent studies and time-of-flight spectrometry are considered. The coupling of the accelerator target to the reactor is illustrated. R.B.

N70-19008 Cornell Univ., Ithaca, N.Y.
COMPARISON OF ELECTRON-PROTON AND POSITRON-PROTON ELASTIC SCATTERING CROSS SECTIONS
George Lawrence Cassiday, Jr. (Ph.D. Thesis) 1968 170 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-8832

The ratio of electron-proton and positron-proton elastic scattering differential cross sections under an identical kinematical configuration was measured. The lepton beam was made by allowing the external bremsstrahlung gamma beam from the Cornell 2-GeV synchrotron to a strike a 1-radiation-length lead target. Electrons or positrons were then selected by a beam transport system which momentum analyzed and focused them on a 46-cm-long liquid-helium target. The energy of the beam was maintained at 1700 + or - 42 MeV. The mean energy difference of the positron and electron beam was less than 0.2%. The pion contamination was kept to a negligible amount by operating the synchrotron at 1875 MeV. The thin-foil spark chambers, scintillation counters, and lead-glass Cherenkov counters that were used were arranged symmetrically about the incident beam to detect an event. Dissert. Abstr.

N70-19013 New Mexico Univ., Albuquerque.
A STUDY OF THE (t,p) REACTION ON Zr-90, 92, 94, 96 AND Sn-122, 124
Jerome Griggs Beery (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9234

The nuclear energy levels that are populated by putting two neutrons into a target nculeus are investigated. The targets were bombarded with 20-MeV tritons from the Los Alamos tanden Van de Graaff facility. Protons were detected with a solid state counter telescope and the data was recorded with an on-line digital computer. Energy spectra were taken for each of the targets utilizing a magnetic spectrometer in order to obtain excitation energies with an accuracy of + or - 10 keV. The zirconium data is analyzed with a distorted wave Born-approximation calculation

and relative spectroscopic strengths are obtained. The energy level positions and strengths are compared to a nuclear structure calculation. Dissert. Abstr.

N70-19018 Maryland Univ., College Park.
THE LOCALIZED MAGNETIC IMPURITY AND SPIN CORRELATIONS
Martin Stanley Fullenbaum (Ph.D. Thesis) 1968 113 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-10124

The interaction of a localized impurity moment interacting with an electron gas by means of the S-d contact interaction was considered in the light of the Kondo resistance minimum. The Kondo resistance minimum is reviewed and it is seen that perturbation theory is no longer valid for temperature less than the Kondo temperature, T sub k. The breakdown of perturbation theory below this temperature requires a nonperturbative theory. In the low temperature region where perturbation theory is not applicable, the electron spin impurity spin correlation function was examined. In the ground state predicted from an exact solution of Nagaoka's equations, no spatially oscillating terms are shown to exist in the correlation function. In the high temperature region where the application of perturbation theory is valid, the Green's function was computed in the presence of a magnetic field to second order in J, the s-d coupling constant. It is shown that spin-flip terms in second order give a correction to the Ruderman-Kittel-Kasuya-Yosida (RKKY) electron spin polarization. Dissert. Abstr.

N70-19072# Bettis Atomic Power Lab., Pittsburgh, Pa.
REDUX: A FORTRAN 4 PROGRAM FOR CALCULATION OF STATISTICAL PARAMETERS FROM COUNT SAMPLES MEASURED IN REACTOR FLUCTUATION EXPERIMENTS
D. R. Harris and M. Natelson Sep. 1969 22 p refs
(Contract AT(11-1-GEN-14)
(WAPD-TM-811) Avail: CFSTI

REDUX is a FORTRAN-IV program for reduction of data from reactor fluctuation experiments. From input count samples recorded by one or two counting channels, the program computes sample moments about the origin, unbiased estimates of central moments and cumulants of orders less than five, certain distribution characters such as skewness, excess of kurtosis and conventional coefficient of correlation, together with the dispersion parameter gamma and modified coefficient of correlation MCC. Bias and standard error estimates are computed for gamma and MCC. The program also computes these statistics for count samples formed by combining in various ways counts of the input count samples. 6 references. Author (NSA)

N70-19074# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.
STUDIES ON THE STABILIZATION OF UO2 WITH Y2O3 ADDITIONS
S. F. Bartram and E. S. Fitzsimmons Sep. 1969 24 p refs
(Contract AT(40-1)-2847)
(GEMP-709) Avail: CFSTI

The stabilizing effect of certain R2O2 additives on UO2 probably occurs by inhibiting vaporization of UO2 + O2 from the surface of the solid particles. The lower vapor pressure of Y2O3 at the surface of the specimens would satisfactorily explain the results. Under free vaporization conditions, the oxygen-to-uranium ratio decreases at a rate determined by vaporization of uranium which is controlled by surface composition. In tantalum capsules the oxygen can diffuse from the pellet through the tantalum until the oxygen activities inside the capsule and in the gas stream are equal. Analysis of these UO2 solid solutions is very difficult. The free metal and oxide phases will oxidize independently but the composition of the fluorite solid solution changes with time and temperature by disporportionation to alpha-U2O8 and a FCC phase richer in Y2O3. Furthermore, other phases may form; these make the analysis even more complicated. Author (NSA)

N70-19079 National Lending Library For Science and Technology, Boston Spa (England).
EFFECT OF AFTERPULSES IN SECONDARY ELECTRON PHOTOMULTIPLIERS USED FOR LIQUID SCINTILLATION COUNTING
K. Friedrich et al 18 Jul. 1969 16 p refs Transl. into ENGLISH from Isotopenpraxis (Berlin), v. 4, no. 7, 1968 p 251-255
(NLL-T-6426-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: .2 NLL photocopy coupons

The effect of afterpulses on some samples of the multiplier used in liquid scintillation counting was investigated as a function of different parameters. From the study, practical guidelines resulted that must always be taken into account in absolute measurements of activity using liquid scintillation counters, if spurious measurements due to afterpulses are to be avoided. Author

N70-19085# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
TEST OF THE INDEPENDENCE HYPOTHESIS BY ANGULAR DISTRIBUTION MEASUREMENTS
N. T. Porile and D. M. Montgomery 20 Oct. 1969 19 p refs
(Contract AT(11-1)-1505)
(COO-1505-40) Avail: CFSTI

Angular distribution measurements of Ce-137m and Ce-137g from the reactions Ba-136(He-4,3n) and Ba-137(He-3,3n) were made over the energy range from 33.3 to 43.6 MeV and from 20.3 to 32.5 MeV, respectively. The results were analyzed to give the average total kinetic energy of the neutrons and photons emitted in the reactions. Comparison of these quantities at the same excitation energy and angular momentum of the compound nuclei shows that they are equal within the limits of error and thereby confirms the independence hypothesis. The observed differences in the average photon energies for reactions leading to Ce-137m and Ce-137g are quantitatively related to the difference in the average angular momentum of compound nuclei leading to each isomer. Author (NSA)

N70-19094# Texas Nuclear Corp., Austin.
GAMMA-RAY YIELD FROM NEUTRON INTERACTIONS WITH B 10
Donald O. Nellis, W. E. Tucker, and Ira L. Morgan [1968] 30 p refs Sponsored in part by AEC
(ORO-2791-29) Avail: CFSTI

Cross sections for gamma rays produced by neutron bombardment of the B-10 were measured between 50 keV and 5 MeV and 14.8 MeV. Special emphasis was placed on measurements of the 0.478-MeV gamma ray from the B-10(n,alpha)Li-7 reaction. Most of the unbounded levels in B-10 did not emit any observable gamma rays. The 0.478 MeV gamma-ray production cross section showed a departure from 1/v above a neutron energy of 100 keV. Author (NSA)

N70-19111# Bettis Atomic Power Lab., Pittsburgh, Pa.
RELEASE OF FISSION GASES FROM OXIDE FUELS (LWBR DEVELOPMENT PROGRAM)
H. R. Warner Jul. 1969 21 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-805) Avail: CFSTI

A quantitative analysis of the movement of fission-gas bubbles in solids by the mechanism of surface diffusion under a thermal gradient is presented. Interactions of the bubbles with dislocations and grain boundaries are invoked to develop a comprehensive scheme of fission-gas release in oxide fuel rods. A quantitative treatment which is in good accord with the limited experimental data which are available from carefully-controlled irradiation experiments is included. Author (NSA)

N70-19116 New York Univ., N.Y. School of Engineering and Science.
LINEAR EXTRAPOLATION DISTANCES FOR CENTRAL AND ECCENTRIC CONTROL RODS IN CYLINDRICAL GEOMETRY: AN EXPERIMENTAL STUDY

Fahir Ibrahim Borak (Ph.D. Thesis) 1968 144 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 69-7702

Linear extrapolation distances for central and eccentric black control rods in cylindrical geometries were determined by the pulsed neutron method. It is found that for a given radius control rod, extrapolation distance increased with increasing moderator radius. Linear extrapolation distance is also found to increase with eccentrical location of control rods. In general, the values of the extrapolation distances determined for central rods, in the range of moderator radii studied, are higher in value by 10-100% than those given by the theoretical calculations of Davison and Kushneriuk. The values of the linear extrapolation distances for eccentric control rods, in the range of moderator radii studied, are also higher than the central control rod extrapolation distances up to a factor of 6, the increase depending on the location of the control rod. Diffusion parameters of water moderator assemblies, to study the dependence of these coefficients on the radial-to-axial buckling ratio, have also been determined by the pulsed neutron method. Dissert. Abstr.

N70-19132# Sloan-Kettering Inst. for Cancer Research, New York. Biophysics Div.
SPECTRA OF HIGH-ENERGY ELECTRON BEAMS IN WATER
Nikitas D. Kessaris 1969 24 p refs
(NYO-910-131) Avail: CFSTI

The spectra of electrons in the energy range 10 to 20 MeV incident on water are obtained theoretically by solving the appropriate transport equation by the moment method. The spectra of the primary (incident) electrons as a function of depth are obtained first, and they subsequently serve as the source of secondaries for which an analogous equation is solved. Author (NSA)

N70-19133# Purdue Univ., Lafayette, Ind. Physics Dept.
ANGULAR DISTRIBUTIONS OF CONVERSION ELECTRONS
R. M. Steffen 11 Aug. 1969 91 p refs Presented at the Intern. Conf. on Radioactivity in Nucl. Spectry., Nashville, 11-15 Aug. 1969
(Contract AT(11-1)-1746)
(COO-1746-26; CONF-690818-4) Avail: CFSTI

The angular (directional and polarization) distribution of internal conversion electrons emitted from oriented nuclear states is discussed. The oriented nuclear states may be produced by low temperature orientation, by nuclear reactions or by the observation of a preceding radiation (angular correlation). A survey of the theory of the conversion electron particle parameters which characterize the angular distributions of conversion electrons is presented and the influence of penetration effects and of EO transitions on the angular distributions is discussed. Author (NSA)

N70-19142# Tokyo Univ. of Education (Japan). Dept. of Physics.
ON THE APPLICATION OF THE VENEZIANO AMPLITUDE TO ELECTROMAGNETIC MASS DIFFERENCES OF PI AND K MESONS
Toshiyuki Minamikawa, Ichiro Shibasaki, and Tsunetoshi Watanabe Sep. 1969 45 p refs
(TUEP-69-17) Avail: CFSTI

Using this result, the Veneziano amplitudes are applied to the calculation of electromagnetic mass differences of pion and K mesons under the assumption of the field current identity, SU(3) symmetry, and gage invariance. Delta M sub k can be made negative by a term corresponding to tadpole diagram exchanging A sub 2 meson. Based on Veneziano model and field algebra, the whole integral is convergent. Author

N70-19149# Idaho Nuclear Corp., Idaho Falls.
THE MTR 25 KeV NEUTRON BEAM
B. W. Howes, R. M. Brugger, J. W. Rogers, R. P. Schuman, F. B. Simpson et al Jul. 1969 36 p refs
(Contract AT(10-1)-1230)
(IN-1308) Avail: CFSTI

A nearly monochromatic beam of 25 keV neutrons has been obtained from the HG-5 beam facility of the Materials Testing Reactor (MTR) by using a combination of natural Fe, Al, and S filters. The actual peak energy of the beam is 24.5 + or - 0.5 KeV and the full-width-at-half-maximum is approximately 1.8 keV. This well collimated beam has an initial diameter of 3.50 inches and a neutron flux of approximately 2 × 100,000 neutrons/sq cm/sec. The gamma ray field associated with the beam was found to be less than 20 mr/hr. The neutron energy spectrum of the beam was analyzed from 1 keV to 1 MeV with a proton-recoil spectrometer. The raw proton-recoil data which were obtained with a H2 filled detector and a multichannel pulse height analyzer were used to optimize the beam, i.e., to obtain the maximum ratio between the magnitude of the 25 keV neutron peak and the general background level. The best signal-to-background ratio was obtained with 26.84 in. of Fe (99.72%), 8.22 in. of Al (99.99%), and 2.31 in. of S (99.9%). The background intensity was reduced to approximately 2% of the 25 keV neutron-intensity. Author (NSA)

N70-19160# Gulf General Atomic, San Diego, Calif.
ENERGY DEPOSITION STUDIES Annual Report
D. A. Vroom 26 Sep. 1969 84 p refs
(Contract AT(04-3)-167)
(GA-9713) Avail: CFSTI

Measurements of energy and angular distributions of ionization electrons ejected from Ar and N2 by electron impact are described. Results are given for electron impact energies of 1 to 15 keV. Work on dissociative excitation of hydrogen-containing molecules by electron impact is summarized. No specific results are given. Three preprints of papers submitted for publication are included. NSA

N70-19151 Wisconsin Univ., Madison.
INTERPRETATION OF CHARGE TRANSFER SPECTRA OF TRANSITION METAL DICHLORIDES
Howard Stephen Stoker (Ph.D. Thesis) 1968 172 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 68-17938

The applicability of a ligand field model to the interpretation of charge transfer spectra of transition metal compounds is investigated. The model is applied to the spectra of the matrix-isolated dichlorides of manganese, iron, cobalt, and nickel. The principles developed for interpreting d-d transition spectra are modified to include the two-center electrostatic interactions which arise as a result of charge transfer. Variation of each of the parameters in the model is examined in detail. It is found that agreement may be achieved using either linear or bent excited states and that interpretations are possible by use of a constant set of parameters for the whole series of compounds or by permitting reasonable variation of each parameter independent of the others. Dissert. Abstr.

N70-19152 Wisconsin Univ., Madison.
MONTE CARLO SIMULATION OF RADIATIVE TRANSFER IN A CYLINDRICAL MEDIUM
Ralph Erwin Stockhausen (Ph.D. Thesis) 1968 152 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 69-1002

The radiative output is obtained from a three-level atom in a non-uniform cylindrically shaped medium of infinite length. The non-uniformities are approximated by a series of uniform but different zones. For the transfer problem complete re-distribution of frequencies within a Doppler profile is assumed. The level populations of the atoms are obtained by solving the equations of statistical equilibrium among the various collisional and radiative processes. A zero order, collision-only set of level population gives the initial injection rate for photons. Successive solutions of the

radiation field allow derivation of self-consistent level populations and radiation fields. The solution of the emitted radiation field is obtained by an application of Monte Carlo simulation techniques.
Dissert. Abstr.

N70-19156# California Univ., Berkeley. Lawrence Radiation Lab.
ON THE MICROSCOPIC AND MACROSCOPIC ASPECTS OF NUCLEAR STRUCTURE WITH APPLICATION TO SUPERHEAVY NUCLEI
Chin-fu Tsang 22 May 1969 209 p refs
(Contract W-7405-eng-48)
(UCRL-18899) Avail: CFSTI

The relation between a microscopic approach and a macroscopic approach to the study of the nuclear binding energy as a function of neutron number, proton number and nuclear deformations, is studied. The discussion is illustrated by a study of noninteracting particles in an orthorhombic potential well with zero potential inside and infinite potential outside. The total energy is calculated both exactly and also from a liquid drop type of expression. The saddle point shapes of a charged conducting drop on a pure liquid drop model are examined. The properties of a conducting drop are compared with those of a drop whose charges are distributed uniformly throughout its volume. The Strutinski method is to synthesize a microscopic approach and a macroscopic approach. The results are applied to realistic nuclei. The possible occurrence of shape isomers comes as a natural consequence of the calculation. Their trends as a function of neutron and proton members are discussed and the results are tabulated. The possible experimental production of these superheavy nuclei are also discussed.
Author (NSA)

N70-19157# Israel Atomic Energy Commission, Tel Aviv.
CRITERION FOR COMPARING ANALYZERS
H. Z. Sar-El Jan. 1969 17 p refs
(IA-1183) Avail: CFSTI

In view of the recent development of several new electrostatic analyzers, the need arises for a criterion for comparing their figures of merit. A criterion usually used in beta-spectrometry is proposed, with reservations, and is shown to be preferable to another criterion.
Author (NSA)

N70-19158# California Univ., Berkeley. Lawrence Radiation Lab.
CHARGED PION LIFETIME MEASURED IN FLIGHT
Arthur J. Greenberg 1 Aug. 1969 157 p refs
(Contract W-7405-eng-48)
(UCRL-19300) Avail: CFSTI

The lifetime of the charged pi meson was found by determining as a function of distance the number of surviving pions in a narrow beam. Measurements for both pion (+) and pion (-) were made along a 36-ft decay path equivalent to 0.6 lifetime, using a movable pion detector. The monitor counters defining the beam were designed so that the measured attenuation with distance was due solely to pion decay and not to loss of scattered particles. The attenuation together with the pion velocity, derived from a precise time-of-flight measurement, determined the lifetime. The movable counter and the pion detector in the monitor system were differential Cerenkov counters with a liquid hydrogen radiator. The lifetime measured in this experiment with pions in flight, 26.02 + or - 0.04 nsec, is in agreement with other equally precise experiments with positive pions at rest. Comparison of the lifetimes measured with pions in these two states of motion is relevant to the question of microcausality in field theory.
Author (NSA)

N70-19159# Israel Atomic Energy Commission, Tel Aviv.
GLDT: AN IMPROVED FORTRAN 4 COMPUTER PROGRAM FOR THE LEAST SQUARES ANALYSIS OF GAMMA-RAY SPECTRA
A. Gavron May 1969 17 p refs
(IA-1193) Avail: CFSTI

GLDT is a computer program which decomposes the gamma ray spectra of mixtures of radionuclides. Special attention was paid to the simplification of the input data, thus paving the way for complete automation of the data transfer from the multichannel analyzer to the computer. The computer automatically performs spectrum shifting, corrects the spectrum for detector or analyzer nonlinearity, compensates the number of counts in each channel for dead time losses, calculates the detection limit of each radionuclide component, and rejects superfluous radionuclide strandards.
Author (NSA)

N70-19171# Brookhaven National Lab., Upton, N.Y. Health Physics Div.
COMPARISON OF DISTANCE- AND ENERGY-RESTRICTED LINEAR ENERGY TRANSFER FOR HEAVY PARTICLES WITH 0.25 TO 1000 MeV/amu
J. W. Baum [1969] 15 p refs Presented at the 2d Symp. on Microdosimetry, Ispra, Italy, 20-24 Oct. 1969 Sponsored by AEC
(BNL-13998; CONF-691012-1) Avail: CFSTI

While linear energy transfer (LET) has been a very useful concept in radiobiology, its limitations have often been noted. Frequently, correlation with radiobiological data has been improved by considering total LET in terms of a track-core fraction and a delta-ray fraction. The track core fraction can be estimated either for restricted delta-ray energy L sub delta or for restricted track radius L sub r. L sub delta is somewhat easier to calculate but L sub r relates better to energy locally deposited. A new and simple method for calculating L sub r is presented. Classical collision theory is used to predict energy, angle and number of secondary electrons. Cole's recent range-energy data are employed to determine energy deposition by electrons as they leave the track core. Results are compared for the two concepts. Largest differences are found for low energy particles and small track radii.
Author (NSA)

N70-19201# Los Alamos Scientific Lab., N.Mex.
TEMPERATURE DEPENDENCE OF THERMAL NEUTRON LEAKAGE IN UHTREX
John C. Vigil 15 May 1969 3 p refs
(Contract W-7405-eng-36)
(LA-4190) Avail: CFSTI

Calculations show that if the room temperature calibration of the B-10 chambers is used for design conditions, the power readings will be high by a factor of 2.8. This is due to changes in the thermal neutron absorption in the reactor vessel.
Author (NSA)

N70-19206 Tennessee Univ., Knoxville.
THE APPLICATION OF FILTERS TO TIME ANALYSIS OF SIGNALS FROM Ge(Li) DETECTORS
Terry Dean Douglass (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-7151

An optimum filter which minimizes the effect of noise on time measurement was determined and the minimum timing error associated with this optimum filter was found. For the signal and noise from a Ge(Li) detector, charge-sensitive preamplifier system, the optimum filter is physically non-realizable. The effect of certain realizable RC filters on the reduction of the time measurement error due to noise is presented. The filters examined were time-invariant and time-variant RC high-pass, RC low-pass, and the combination of RC low-pass, RC high-pass filters. Both theoretical and experimental data were examined to determine the best filter. The advantages of the time-variant filters were lower discriminator levels, allowing the reduction of the effect of charge collection variations, and lower time measurement errors due to noise at the low discriminator levels.
Dissert. Abstr.

N70-19232*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRON EXCHANGE IN H-H COLLISIONS: THE HEITLER-LONDON CURVES AS A FUNCTION OF

INTERNUCLEAR DISTANCE AND VELOCITY
A. B. Ritchie Jan. 1970 18 p refs Submitted for publication
(NASA-TM-X-63823; X-641-70-7) Avail: CFSTI CSCL 20H

The Heitler-London curves for the interaction of two hydrogen atoms are calculated as a function of the internuclear distance and velocity. Electron exchange terms are found to dominate the interaction energy at laboratory energy 1 kev, to be quite significant at 25 kev, and to be negligible at 400 kev. The exchange energy is attractive at 25 kev and below, but at 100 kev it is repulsive. Hence in going from 25 to 100 kev the Singlet and Triplet curves go from attractive and repulsive to repulsive and attractive, respectively, suggesting that an oscillatory behavior of the cross-section versus energy is possible. These results have important implications for the calculation of atom-atom excitation cross-sections in this energy range. Author

N70-19240# Argonne National Lab., Ill.
PHYSICS DIVISION Summary Report, Apr.-Dec. 1968
Dec. 1968 165 p refs
(Contract W-31-109-eng-38)
(ANL-7512) Avail: CFSTI

Short summaries are presented of research projects completed or in progress during April through December, 1968, at the Physics Division of Argonne National Laboratory. NSA

N70-19243# California Univ., Berkeley. Lawrence Radiation Lab.
RADIOACTIVATION BY He 3 BOMBARDMENT: A PRACTICAL ANALYTICAL SYSTEM
James Francis Lamb (Ph.D. Thesis) Sep. 1969 230 p refs
(Contract W-7405-eng-48)
(UCRL-18981) Avail: CFSTI

Charged-particle activation analysis using 1- to 30-MeV He-3 ions as the nuclear reaction inducing particle is discussed from a practical point of view with emphasis on the light elements, especially oxygen. Definitions and expressions fundamental to charged-particle activation analysis are given with brief discussions. Also included are convenient He-3 activation analysis reference curves for estimating Coulomb barriers and the effects of Rutherford scattering on the incident beam. Range energy tables for He-3 ions in nongaseous targets of the stable isotopes of all elements and an extensive Q-value table for the more important He-3 induced reactions appear as appendices. A summary of excitation functions and reaction data for He-3 induced reactions in Be, B, C, N, O, F, Na, Mg, Al, Si, Ca, Ti, Fe, Ni, Cu, Ge, Ta, and Au is given; it contains experimental measurements as well as values from the literature. All the excitation functions were redrawn to the same scale to permit convenient comparison. Author (NSA)

N70-19253# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE STRUCTURE OF DATA FIELDS 78 AND 79 FOR NIOBIUM, AND FILE 81 FOR MOLYBDENUM, IN THE UKAEA NUCLEAR DATA LIBRARY
S. Blow and B. A. Lipscombe Jun. 1969 11 p refs
(AERE-M-2230) Avail: HMSO 2s 6d; BIS $0.50; CFSTI

The sources of information, and the nuclear reactions which were considered, in setting up nuclear data files for the following nuclides: Nb at 900 K, Nb at 300 K, and Mo at 300 K, are listed. Author (NSA)

N70-19262# Argonne National Lab., Ill.
PHYSICS DIVISION Summary Report, Jan. – Mar. 1969
Mar. 1969 59 p refs
(Contract W-31-109-eng-38)
(ANL-7570) Avail: CFSTI

Short summaries are presented of research projects completed or in progress during the period January through March, 1969 at the Physics Division of Argonne National Laboratory. NSA

N70-19281 Rutgers Univ., New Brunswick, N.J.
MOLECULAR PHOSPHORESCENCE: A THEORETICAL AND EXPERIMENTAL STUDY
Jack Leon Ginsburg (Ph.D. Thesis) 1969 103 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-7541

The effect of the two-electron spin-same and spin-other orbit interactions on singlet-triplet transitions in the azines and formaldehyde was studied. The investigation shows that, although a one-electron approximation to the spin-orbit Hamiltonian is conceptually valid for calculating S-T transition probabilities, the commonly used one-electron approximation, the screened nuclear field approximation, is incorrect. The best one-electron approximation is the bare nuclear field spin-orbit Hamiltonian. Halogen substitution has a greater effect on vibronic interactions than on the spin-orbit interactions as evidenced by the increased relative intensity of the phenanthrene analogue nontotally symmetric bands. The important enhancement mechanism in 3-chloro and 9-bromophenanthrene involves vibronic interaction. Dissert. Abstr.

N70-19285# Atomic Energy Commission, Washington, D.C. Office of Safeguards and Materials Management.
SAFEGUARDS AND NUCLEAR MATERIALS MANAGEMENT
Guy M. Inman, comp. 15 Oct. 1969 44 p refs
(WASH-1141) Avail: CFSTI

A total of 213 references to unclassified reports, journal articles, conference papers, and other literature pertinent to Safeguards and Nuclear Materials Management is included. The material was taken from that appearing in Nuclear Science Abstracts from January 1, 1965 to July 30, 1969. The references are arranged according to the subjects listed in the table of contents. Personal author, report number, and corporate or issuing agency indexes are provided. Author (NSA)

N70-19291# California Univ., Los Angeles. Physics Dept.
PROTON TOTAL REACTION CROSS SECTIONS FOR LIGHT NUCLEI BETWEEN 24 AND 46 MeV
William F. McGill Sep. 1969 94 p refs
(Contract AT(11-1)-GEN-10)
(UCLA-10-P-18-14; TR-P-83) Avail: CFSTI

Proton total reaction cross sections for Be-9, C-12, O-16, F-19, Al-27, and natural Si were measured at 24 to 46 MeV with an uncertainty of 2 to 3%. The data were compared with optical-model calculations in the same energy range. The optical-model predictions were found to be in excellent agreement with measured values for silicon and aluminum. The predictions for oxygen and carbon were fair while those for beryllium were poor. NSA

N70-19294 New Mexico Univ., Albuquerque.
THE APPROXIMATE SCF LCAO-MO WITH CNDO THEORY AND ELECTRONIC STRUCTURES OF NITROGEN-HETEROCYCLIC BENZENE ANALOGUES
Jay Jea-Yong Rhee (Ph.D. Thesis) 1968 184 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 69-9262

The approximate MO theory considered explicitly refers to the Pople molecular orbital treatment. This consists of complete neglect of differential overlap in the self-consistent field treatment of the molecular orbitals, analogous to the Hartree – Fock treatment of atomic systems, which are constructed as linear combinations of atomic orbitals. Furthermore, the only orbital functions considered in a basis set are those for the valence electrons and the atomic orbitals are Slater-type orbitals. The approximate MO theory is applied to the series of nitrogen heterocyclic benzene analogues. The quantities that have been calculated are eigenvalues, eigenvectors, charge densities, bond orders, population analysis, and dipole moment for each molecule. A correlation of the orbital energies is made between the molecules and some comparisons are made between experimental and theoretical values. Dissert. Abstr.

N70-19335 North Carolina Univ., Chapel Hill.
CLASSICAL RELATIVISTIC MECHANICS OF PARTICLES WITH SPIN
Peter Byerly Eby (Ph.D. Thesis) 1968 69 p
Avail: Univ. Microfilms: HC $3.80/Microfilm $3.00 Order No. 69-10155

It is possible to describe interactions of classical particles from the point of view of direct action as well as from the particle-field point of view and these two viewpoints can play complementary roles. The former approach attempts to construct an action-at-a-distance theory for particles with spin consistent with relativistic invariance and the conservation laws for linear and angular momentum. This theory contains as a special case the half retarded plus half advanced electrodynamics of charged particles with spin. The equations of motion for a particle in an external electromagnetic field corresponds to this special case and is compared with equations of some of the standard theories of spinning particles in electromagnetic fields. The main points of difference are that the equations include the possibility of variable mass and spin magnitude and the theory insures the validity of Newton's First Law. Dissert. Abstr.

N70-19338# Kentucky Univ., Lexington. Dept. of Physics and Astronomy.
CHARGED PARTICLE INTERACTION WITH NOBLE GASES Annual Progress Report, 15 Apr. 1968 - 14 Apr. 1969
G. S. Hurst Dec. 1968 52 p refs
(Contract AT(40-1)-3650)
(ORO-3650-2) Avail: CFSTI

Progress is reported briefly on the following: proton excitation of the Ar atom, Jesse effects and quenching of continuous emission in Ar, radiation transport theory, and proton excitation of the He atom. A mechanism is tentatively proposed to obtain recent results concerning the Jesse effect in Ar. In work on the Franck - Condon process in Ar, a cross section for the process of 4 $\times$ 10 to the minus 19th power sq cm was obtained. New facilities and experimental designs are described briefly. A reprint of a published paper and a preprint of a paper to be published on proton excitation of the Ar atom are included. NSA

N70-19342# California Univ., Berkeley. Lawrence Radiation Lab.
RESONANCE PRODUCTION IN THE REACTION PION(+) DEUTERIUM YIELDS PROTON PROTON PION PION
Robert J. Manning (Ph.D. Thesis) Sep. 1969 134 p refs
(UCRL-19339) Avail: CFSTI

In an analysis of 229,000 pictures of pion(+) at incident momenta of 1.1 to 2.3 GeV/c in the deuterium-filled 72-inch bubble chamber, 41,045 examples of the reaction pion(+)d yields proton proton pion(+) pion (-) were identified. A phase shift analysis was attempted on the angular distribution moments of off-mass-shell pion-pion scattering for low momentum transfer events (production angle cosine from beam to outgoing mesons >0.8). This resulted in four distinct solutions for the I = 0, J = 0 pion-pion scattering phase shift. The solution which rises slowly to nearly 90 deg at a pion-pion mass of 700 MeV and remains near 90 deg for pion-pion masses between 700 and 1000 MeV is preferred over the solutions by comparison with the subtracted pion(0)pion(0) mass spectrum. At values of center-of-mass energy >2.1 GeV forward peaking was found in the single meson exchange forbidden reaction pion(+) N yields delta (2+)(1238)pion(-). In the same reaction backward peaking was also observed inconsistent with simple J = 1/2 baryon exchange in the u-channel. Author (NSA)

N70-19348# Iowa State Univ. of Science and Technology, Ames.
SILICON DETECTOR STUDIES OF NUCLEAR INTERNAL CONVERSION IN SM-155 AND ND-151
David Francis Boneau (Ph.D. Thesis) May 1969 161 p refs
(Contract W-7405-eng-82)
(IS-T-305) Avail: CFSTI

The intensities of conversion electrons from the decays of short-lived Sm-155 and Nd-151 were studied with a lithium-drifted silicon detector. The competing effects of continuous beta rays were reduced by requiring time coincidences between conversion electrons and beta rays. A system of monoenergetic response functions was employed to unfold the conversion electron spectra. Relative intensities were obtained for twenty conversion lines in the Eu-155 daughter and for thirty-seven Pm-151. The present results were combined with gamma-ray intensities determined by others to produce internal conversion coefficients for many transitions in Eu-155 and Pm-151. The conversion coefficients indicate that the low-lying levels in both nuclei consist of the first two members of the Nilsson bands. Conversion coefficients are reported for some transitions in Pm-151 that are not yet placed in the Nd-151 decay scheme. Author (NS

N70-19364# Brookhaven National Lab., Upton, N.Y.
ON THE BEHAVIOR OF AEROSOLS UNDER FAST REACTOR ACCIDENT CONDITIONS
A. W. Castleman, Jr., F. L. Horn, and G. C. Lindauer Sep. 1969 18 p refs Presented at the Intern. Congr. on the Diffusion of Fission Prod., Saclay, France, 4-6 Nov. 1969 Sponsored by AEC
(BNL-14070; Conf-691104-1) Avail: CFSTI

The results of theoretical and experimental studies of the characteristics of PuO2 and UO2 aerosols are presented. A computer program was developed to calculate the time dependence of the aerosol behavior taking into account relationships for thermal, sedimentation, turbulent coagulation, and particle deposition. The results of a parametric study show that the variation with time of aerosol mass concentration is strongly dependent on the initial concentration value and the associated initial particle size distribution. Theoretical results, in agreement with experiment, show that the average aerosol particle size increases with time, approaches a maximum, and then decreases to a nearly constant value. Experimental results are given for PuO2 and UO2 aerosols generated in a 1-meter high settling chamber. A comparison of these results with the calculations made employing the theoretical model shows good agreement. Author (NSA)

N70-19367# Institute of Nuclear Research, Warsaw (Poland).
INSTITUTE OF NUCLEAR RESEARCH, YEAR 1968 Annual Report
1969 207 p refs In POLISH
(INR-1100) Avail: CFSTI

A brief review is given of research in the fields of nuclear physics, including nuclear reactions, nuclear spectroscopy, high energy physics, plasma physics, and nuclear electronics. Research programs in nuclear chemistry, radiobiology, reactor technology, isotope technology, and high temperature technology including MHD generators are also outlined. Lists of publications during the year are included after each section. NSA

N70-19383# California Univ., Berkeley. Lawrence Radiation Lab.
RADIATION-RESISTANT CHROMIUM-ACTIVATED ALUMINUM OXIDE SCINTILLATOR
Robert W. Allison, Jr., Robert W. Brokloff, R. L. Mc Laughlin, Robert M. Richter, Marsh Takawa et al 16 Jul. 1969 7 p
(Contract W-7405-eng-48)
(UCRL-19270) Avail: CFSTI

Chromium-activated radiation resistant scintillators have been produced by anodizing aluminum in a sodium tetraborate solution to which potassium dichromate had been added. These scintillators have been used in a 250-A 3.4-MeV 300-nsec electron beam, with no noticeable radiation damage. Tests have also been done with 5-GeV protons, with similar results. Author (NSA)

N70-19390# California Univ., Berkeley. Lawrence Radiation Lab.
BEVATRON OPERATION AND DEVELOPMENT, 61 Quarterly Report, Jan.-Mar. 1969
Kenneth C. Crebbin, Don M. Evans, and Robert Frias Jun. 1969

14 p
(Contract W-7405-eng-48)
(UCRL-19232) Avail: CFSTI

The beam was on for experimenters 81.9% of the scheduled operating time. During this period the bevatron accelerated 1.9 x 10 to the 18th power protons. Beams were provided for 12 primary experiments and three primary experiments were completed The external beam transport magnets have been placed under computer control. This, coupled with new bevatron main magnet pulsing modes, has greatly increased the flexibility of machine operation and the ability to satisfy simultaneously the needs of a number of experiments. The extraction efficiency, for short beam pulses as required by the bubble chamber, has been doubled by going to an outer-radius target. Author (NSA)

N70-19396# California Univ., Los Angeles. Dept. of Physics.
KINEMATICALLY INCOMPLETE AND COMPLETE STUDIES OF THE BREAKUP OF He 4 BY 47-MeV PROTONS
Joel Guild Rogers Jun. 1969 112 p refs
(Contract AT(11-1)-Gen-10)
(UCLA-10-P-18-15; P-84) Avail: CFSTI

The reactions induced by 47-MeV protons on He-4 were investigated in a kinematically incomplete experiment, by observing triton and deuteron spectra, and in a dinematically complete experiment, by observing correlated triton-proton spectra. Natural helium gas targets were employed. The single counter (kinematically incomplete) observations were performed with a dE/dx-E counter telescope from which two-dimensional pulse height arrays were stored by an on-line computer. Spectra and angular distributions were analyzed using the Watson-Migdal Theory and direct reaction theory of Dar, respectively. The kinematically complete experiment was performed using two counter telescopes, one to observe He-3 and tritons from the reactions and one to observe the correlated portions. Data were stored by the computer in a four dimensional form by serial listing on magnetic tape of four linear signals from each event. Computerized analysis of these data is described. Author (NSA)

N70-19409# Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics.
COULOMB EXCITATION AND REORIENTATION OF THE OCTUPOLE STATE IN Pb-208
A. R. Barnett and W. R. Phillips [1969] 55 p refs Sponsored in part by AEC
(COO-1265-73) Avail: CFSTI

The static quadrupole moment level in Pb-208 was measured by observing the angular distribution of inelastically scattered He-4 and O-16 ions following E3 Coulomb excitation. The reduced matrix element for the E3 transition from the ground state was also obtained. Distributions were taken, using a multiple solid state detector array, at alpha particle energies of 19, 18, and 17.5 MeV, and at an oxygen energy of 69.1 MeV. Differential inelastic cross sections were in the range 10 to 40 microbarns/sr for alpha's and 200 to 300 microbarns/sr for oxygen. The 19-MeV data showed strong interference between the Coulomb excitation amplitude and an amplitude resulting from direct nuclear excitation. The remaining three sets of data showed no such interference and were analyzed simultaneously using the symmetrized semi-classical Coulomb excitation theory. The alpha data are not very sensitive to Q and yet are essential to the result, for the analysis of the alpha and oxygen data together limits the acceptable parameter range much more than if the oxygen data alone are used. Author (NSA)

N70-19411# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
RECOIL RANGES, EXCITATION FUNCTIONS, AND ISOMER RATIOS FOR THE Ba 136(He 4, 3n) AND Ba 137(He 3, 3n) REACTIONS
N. T. Porile and D. M. Montgomery 20 Oct. 1969 27 p refs
(Contract AT(11-1)-1505)
(COO-1505-39) Avail: CFSTI

Average projected ranges and cross sections for the production of Ce-137m and Ce-137g from the Ba-136 (He-4,3n) and Ba-137 (He-3,3n) reactions were measured over the energy intervals 27 to 44 MeV and 11 to 33 MeV, respectively. The average ranges were found to be consistent with a compound nuclear process over the entire energy interval for both reactions. The isomer ratios were compared with a calculation based on the spin-dependent statistical theory and good agreement was obtained for reasonable values of the parameters of interest. Comparison is made with previous measurements and various discrepancies are discussed. Author (NSA)

N70-19412# California Univ., Berkeley. Lawrence Radiation Lab.
EXPERIMENTAL TEST OF TIME-REVERSAL INVARIANCE IN THE PHOTODISINTEGRATION OF THE DEUTERON
B. L. Schrock, J. F. Detoeuf, R. P. Haddock, J. A. Helland, M. J. Longo et al (California Univ., Los Angeles) Sep. 1969 24 p refs
(Contracts Nonr-1224(26); AT(11-1)-34)
(UCRL-19350) Avail: CFSTI

A measurement using spark chambers is made of the angular distributions from the interaction n + p yields d + gamma at 300 to 700 MeV. These data are compared with data from gamma + d yields n + p interactions in order to test time reversal invariance in this interaction. NSA

N70-19419# Illinois Univ., Urbana. Dept. of Physics.
THEORY OF BINARY BOSON SOLUTIONS
Walter E. Massey, Chia-Wei Woo (Argonne Nat. Lab., Ill.), and Hing-Tat Tan (Minnesota Univ) Jun. 1969 28 p refs Sponsored in part by ARPA Prepared in cooperation with Northwestern Univ.
(Contract AT(11-1)-1569)
(COO-1569-51) Avail: CFSTI

The properties of a dilute solution of mass-3 bosons in liquid He-4 at low temperatures are computed via a variational procedure. A set of coupled integro-differential equations is solved, yielding the ground-state energy per particle, the binding energy of He-3 in He-4, the volume excess parameter alpha, the (3,3), and (4,4) distribution functions, and the long-wavelength limit of the effective interaction between He-3 quasi particles in He-4. Results compare favorably with experiment and with phenomenological theories. Author (NSA)

N70-19420# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
AVERAGE RANGES, CROSS SECTIONS, AND ISOMER RATIOS FOR THE Ba 134(ALPHA,n)Ce 137m,g REACTION
N. T. Porile and D. G. Swanson 16 Sep. 1969 24 p refs
(Contract AT(11-1)-1505)
(COO-1505-37) Avail: CFSTI

Excitation functions, isomer ratios, and average recoil ranges were determined for the Ba-134(alpha,neutron) reaction over the energy range from 15 to 28 MeV. The average ranges are compared with values predicted by Lindhard, Scharff, and Schiott on the assumption of compound nucleus formation and are found to be consistent with this mechanism over the energy range studied. The experimental isomer ratios and the excitation function agree well with the results of a spin-dependent statistical model calcultion provided an energy-dependent moment of inertia is used. Author (NSA)

N70-19421# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CROSS SECTIONS OF INELASTIC INTERACTIONS OF alpha-PARTICLES WITH NUCLEI
I. Z. Artykov and V. S. Barashenkov 1969 5 p refs In RUSSIAN
(JINR-P2-4613) Avail: CFSTI

Using an optical model the cross sections of the inelastic interactions of alpha-particles with the C-12, Al-27, Ti-43,49, Fe-55,59 and Cu-63,65 nuclei in the energy range more than 50 MeV were calculated. Author (NSA)

N70-19422# Fribourg Univ. (Switzerland). Inst. de Physique.
DISINTEGRATION OF Rh 104 (43 sec) AND OF Rh 104m (4.4min)
V. A. Ionescu and J. Kern [1969] 4 p refs In FRENCH
Presented at the meeting of the Swiss Phys. Soc., Bern, May 1969
(Conf-690518-1) Avail: CFSTI

For even nuclei, the 2-phonon excitation would consist of triplet states 0(+), 2(+), and 4(+), which have been discovered with certainty in only a few nuclei. The beta decays of Rh-104(1+) and its isomeric state 5(+) are particularly favorable to populate the three terms of the triplet. Measurements made on these levels have shown the activity due to the decay of each of the two levels. Six new transitions at 356, 451, 758.78, 777.8, 923.7, and 1793.5 keV were detected. All the gamma rays observed are placed in a decay scheme given. The observation of a weak but nevertheless certain transition at 1792 keV is in contradiction with the assignment of a spin and parity 0(+) for the level that it depopulates. The transition of 778 keV is probably a new level of spin 0 which is the third term of the triplet sought. NSA

N70-19428# Oak Ridge National Lab., Tenn. Technical Information Div.
THE PREPARATION OF A Pm 147 PHOSPHOR SOURCE
P. Wolf et al. Nov. 1969 4 p refs Transl. into ENGLISH from Radiochim. Acta. (Frankfurt am Main), v. 10, no. 3-4, 1968 p 168-170 Sponsored by AEC
(ORNL-tr-2145) Avail: CFSTI

The preparation of a Pm(147)2O3-ZnS(Cu) light source is described. An assembly of 5 quartz cells with 100 Ci in each and 10 photocells operates as a battery. Author (NSA)

N70-19431# Los Alamos Scientific Lab., N. Mex.
REEVALUATED CRITICAL SPECIFICATION OF SOME LOS ALAMOS FAST-NEUTRON SYSTEMS
G. E. Hansen and H. C. Paxton Sep. 1969 13 p refs
(Contract W-7405-eng-36)
(LA-4208) Avail: CFSTI

Reevaluation of a number of published critical masses of Los Alamos fast neutron critical assemblies is presented. In each case, there is idealization to the appropriate one-dimensional or two-dimensional representation. Minor changes of some published critical specifications result either from improvement of data upon which corrections are based or from more detailed accounting of component dimensions than was originally believed to be justified. Author (NSA)

N70-19436# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
ANGULAR DISTRIBUTIONS OF Ce 137m AND Ce 137g FROM THE Ba 134 (ALPHA,n) REACTION
N. T. Porile and D. G. Swanson 17 Sep. 1969 27 p refs
(Contract AT(11-1)-1505)
(COO-1505-38) Avail: CFSTI

The angular distributions of Ce-137m and Ce-137g nuclei formed in the Ba-134 alpha,n reaction were studied at three different energies in the range between 18 and 25 MeV. The results were compared to a spin-dependent statistical model calculation. Satisfactory agreement was obtained between theory and experiment at small angles. At large angles the calculated differential cross section was smaller than expected from the experimental data. The discrepancy can be attributed to a small contribution from a direct interaction mechanism. Average properties of the angular distributions were used to obtain the average values of the neutron and photon energies, and the difference in the values obtained for the two isomers was interpreted in terms of angular momentum effects. An angular distribution calculation for a hypothetical nucleus suggests that it may be possible to observe striking differences in the angular distribution of alpha,n reaction isomers due to spin fractionation. Author (NSA)

N70-19437# Los Alamos Scientific Lab., N.Mex.
ENTROPY OF INTERACTING POPULATIONS
C. J. Everett and S. M. Ulam Aug. 1969 9 p refs
(Contract W-7405-eng-36)
(LA-4256) Avail: CFSTI

A study is made of interacting populations of particles which closely parallels the Boltzmann kinetic theory and the Planck-Einstein-Tolman treatment of radiation interacting with matter. The analogy is perhaps surprising since it appears that our postulates do not embody the physics of such systems, but are nevertheless quite reasonable, and applicable to similar situations. While we have deliberately used the language of physics for its intuitive appeal, one may well consider for example the implications of replacing particles by people and energy by wealth. It is especially interesting that the reversibility paradox is excluded by confining the discussion to a scalar energy rather than a vector velocity. Author (NSA)

N70-19438# California Univ., Livermore. Lawrence Radiation Lab.
FUSION REACTION POWER CONVERSION STUDIES
P. B. Mohn 4 Sep. 1969 26 p refs Presented at Intern. Conf. on Nucl. Fusion Reactors, Abingdon, Engl., 17-19 Sep. 1969 Submitted for publication Sponsored by AEC
(UCRL-71763; Conf-690901-5) Avail: CFSTI

The recovery of thermal and charged-particle energy from thermonuclear reactions was studied in relation to the energy requirements of plasma confinement, maintenance, and replenishment. Increased conversion efficiency made possible by advances in technology is the principal means examined for offsetting these parasite power requirements. For each value of plasma maintenance power relative to reaction power, a set of conversion system parameters can be determined, which results in minimum net power cost. Since vapor pressures increase and material strengths decrease inexorably with temperature, this minimum increases unrelentingly with both plasma maintenance power fraction and conversion efficiency (temperature) for all systems investigated. Of the conventional thermodynamic systems, binary Rankine cycles appear to offer an attractive combination of efficiency and economics for early reactor designs with presumed moderate-to-high plasma energy losses. Author (NSA)

N70-19440*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ALPHA-GAMMA ANGULAR CORRELATIONS IN THE REACTION NICKEL-58(alpha, alpha PRIME gamma SUB 1.45 MeV)
Norton Baron, Regis Leonard, and William M. Stewart Washington Feb. 1970 34 p refs
(NASA-TN-D-5585; E-5142) Avail: CFSTI

Differential cross sections for elastic scattering and excitation of the 1.452-MeV 2(+) state of nickel-58 were measured for 41-MeV incident alpha particles. The angular correlation between the inelastically scattered alpha particles and the gamma rays emitted in the plane of original scattering in the subsequent nuclear decay were measured also for the excitation of the 1.452-MeV state. The data are compared with optical model calculations of the elastic cross sections and distorted waves Born approximation calculations of the 2(+) cross sections and correlation symmetry angles. Author

N70-19446 Utah State Univ., Logan.
KINEMATICAL AND DYNAMICAL STRUCTURE IN THE SIX-PRONG CHANNELS OF 3.2 GeV/c NEGATIVE PION PROTON INTERACTIONS
Royce Hyrum Allen (Ph.D. Thesis) 1968 109 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-10110

In this experiment 1077 six-prong events at negative pion beam momentum of 3.2 GeV/c have been analyzed yielding a production cross section sigma = 121.7 + or -3.7 micro b. The

data used was 137,000 pictures taken on the 72-inch hydrogen bubble chamber at Lawrence Radiation Laboratory, Berkeley, California. All effective mass distributions obtainable from the final states are presented as well as the cross sections of these final states. It was found that the quasi-two-body isobars dominated the resonance production channels and the associated partial cross sections are presented. The average momentum transfer in the resonance production was found to peak nearer 1.0 (GeV/c)(2) rather than the usual values near zero. In addition angular correlation information for all pion pairs is presented. Dissert. Abstr.

N70-19450# Brookhaven National Lab., Upton, N.Y.
THE BROOKHAVEN AGS RING RADIATION MONITORING SYSTEM
Gerald S. Levine [1969] 11 p Presented at 2nd Intern. Conf. on Accelerator Dosimetry and Experience, Stanford, Calif., 5-7 Nov. 1969 Sponsored by AEC
(BNL-14107; CONF-691101-6) Avail: CFSTI

A radiation monitoring system is described which provides digital information on the location and temporal distribution of radiation in the alternating gradient synchrotron ring. Ionization chambers, symmetrically placed, convert absorbed radiation into pulse information which is passively transmitted to the control room where it is displayed as the data accumulates, is recorded permanently, and is available for counting and scope monitoring. A unique binary display of intensity at each location, as it appears during the accelerator cycle provides an easily comprehended picture of the radiation losses in the machine. The system is insensitive to radiation damage since all the electronics except a pulse transformer are outside the ring. The detectors are nominally calibrated for one output pulse for each millirad of absorbed dose, and are capable of counting with a pulse pair separation of less than 40 microseconds. Author (NSA)

N70-19451# Brookhaven National Lab., Upton, N.Y.
HYPERON BEAMS AT A 200-GeV ACCELERATOR
D. Berley, J. Lach (Yale Univ.), A. Maschke (Natl. Accelerator Lab.), and T. Romanowski (Argonne Natl. Lab., Ill.) Jun. 1968 22 p refs Sponsored by AEC
(BNL-14076) Avail: CFSTI

The possibilities of studying hyperon interactions using the 200-GeV accelerator are discussed. This discussion covers hyperon fluxes from proton collisions, design for a hyperon beam, an experiment for the study of hyperon Omega hyperon (-) decay mode, and a study of Sigma hyperon(-) + proton elastic scattering and other two-body final states. NSA

N70-19452# Institute of Nuclear Research, Warsaw (Poland).
THE MEASUREMENT OF THE SOLID-PHASE-SLIP OF THE STOWING MIXTURE USING RADIOISOTOPES
K. Korbel 1969 26 p refs In POLISH
(INR-P-1057) Avail: CFSTI

Principles and results of flow measurements performed at an industrial storage plant are presented. Results show the relative velocity of solid phase as function of the mean mixture density and grain size. On the basis of results obtained the quantitative dependencies between the real-density and the transport-density of the mixture are determined. Recommendations concerning the possibilities of the washing-up of the large solid particles are included. Author (NSA)

N70-19456# Institute of Nuclear Research, Warsaw (Poland).
USE OF THE SOLID STATE PARTICLE TRACK DETECTORS IN REACTOR MEASUREMENTS
Krystyna Jozefowicz 1969 13 p refs
(INR-1097) Avail: CFSTI

Dielectric track detectors can be used for neutron detection by registering charged particles from interactions of neutrons with matter. Fission fragments as well as light recoil atoms and alpha-particles can be recorded and distinguished in some polymers. The use of particle track detectors in reactor measurements by (n,f) and(n,alpha) reactions and recoil atoms is discussed. The results of measurements of fast neutron flux relative distributions in WWR-SM cores are shown in comparison with sulphur activation results. Further possibilities of the method for absolute and spectral neutron measurements are pointed out. Author (NSA)

N70-19469# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
INTERACTION MECHANISM OF HIGH AND SUPERHIGH ENERGY PARTICLES WITH ATOMIC NUCLEI. NEW TYPES OF ELEMENTARY PARTICLE INTERACTIONS
V. S. Barashenkov, K. K. Gudima, S. M. Eliseev, A. S. Ilinov, and V. S. Toneev 1969 17 p refs In RUSSIAN Presented at the 11th Intern. Conf. on Cosmic Rays, Budapest, 25 Aug.-4 Sep. 1969
(JINR-P2-4662) Avail: CFSTI

The mechanism of intranuclear cascades which is in good agreement with the presently available experimental data on inelastic pion- and nucleon-nucleus interactions in the whole energy range from a few dozens of MeV to a few GeV comes in contradiction with them at higher energies. To eliminate these disagreements it is necessary to take into account many-particle interactions, production of resonances and changes in the nuclear matter density as the intranuclear cascade develops. The analysis of the experimental data is a unique possibility for investigating a new type of elementary particle interactions when in the initial state three, four or more particles (multiple particle interactions) rather than two, as is usually the case, are involved in the collision. Author (NSA)

N70-19470# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SPIN-ORBIT INTERACTION IN THE DEUTERON STRIPPING REACTION ON DEFORMED NUCLEI
H. Schulz and H. J. Wiebicke 1969 10 p refs
(JINR-E4-4686) Avail: CFSTI

In terms of the DWBA the deuteron stripping reaction on deformed nuclei is considered. The Schroedinger equation for the distorted waves is solved by means of the coupled channels procedure. The optical potential includes a spherical spin-orbit coupling part. Exact expressions for the differential cross section and the polarization are obtained. Author (NSA)

N70-19471# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EFFECT OF THE HADRON ELECTROMAGNETIC FORM FACTORS ON THE NEGATIVE PION PROTON YIELDS POSITRON ELECTRON NEUTRON REACTION CROSS SECTION
Yu. S. Syrovtsev and F. G. Tkabuchava 1969 29 p refs In RUSSIAN
(JINR-P2-4561) Avail: CFSTI

A possibility of measuring the form factors of mesons and protons in the reaction pion(-) proton yields positron electron neutron is investigated. The general structure of the matrix element of the process is analyzed. An optimal method for the experimental data analysis is suggested. Author (NSA)

N70-19472# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
EXPERIMENTAL INVESTIGATION OF THE DEVELOPMENT OF ELECTRON-PHOTON SHOWERS AT ENERGIES FROM 20 UP TO 300 MeV
Z. Ogrzevalskii and Z. S. Strugalskii 1969 33 p refs In RUSSIAN
(JINR-P1-4562) Avail: CFSTI

The experimental results concerning fluctuations of average characteristics of the longitudinal and transverse development of the electron-photon showers in the 26-liter xenon bubble chamber are given. The presented data are illustrated. Author (NSA)

N70-19473# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
ISOMERIC M4 TRANSITION IN Po 203
T. Morek, W. Noubert, Ch. Droste, K. Aleksander, S. Chojnacki et al 1969 15 p refs In RUSSIAN
(JINR-P6-4553) Avail: CFSTI

In the reactions Au-197 (B-11,5 neutrons)Po-203 and 0S-190(0-18,5 neutrons)Po-203 an isomeric transition with E sub gamma = 640 + or - I keV and T sub 1/2 = 1.2 + or - 2 min was found. The multipolarity determined via conversion electron measurements is M4. Author (NSA)

N70-19475# Illinois Univ., Urbana.
X1-MINUS HYPERON PRODUCTION IN K-MINUS PROTON INTERACTIONS AT 5.5 GeV/C
Peter Frank Schultz (Ph.D. Thesis) 1969 162 p refs
(Contract AT(11-1)-1195)
(COO-1195-165) Avail: CFSTI

The results of an investigation of the production of Xi(-) hyperons in K(-)p interactions at 5.5 BeV/c are presented. The data were obtained from a 400,000 picture exposure of the MURA 30 in hydrogen bubble chamber at the Argonne National Laboratory. Production cross sections for the Xi(-) hyperon final states and for the Xi*(1530) and K*(890) resonances are given. Center of mass angular distributions in the 2, 3, and quasi-3 body final states are characterized by the forward peaking of the Xi(-) pion. An exception is the Xi(-)K(+) phi final state in which the phi meson is observed to go forward in the center of mass. The Xi(-) pion distribution has evidence for the production of the pion*(1930) resonance. The mass and width are 1955 + or 14 MeV and 56 + or - 26 MeV. A very narrow structure Tau < 30 MeV, at a mass of 2295 + or - 15 MeV is observed in the Delta i(-) pion(+) pion (-) mass distribution of the 4 and 5 body final states. The mass of the Xi(-) is measured to be 1321.8 + or - 0.4 MeV. Details of a search for and the identification of omega(-) hyperons are given. The mass of the omega(-) is measured to be 1671.8 + or - 0.9 MeV as determined from three unambiguous cases of omega(-) production and decay. Author (NSA)

N70-19478# Institute of Nuclear Physics, Krakow (Poland).
LECTURES ON HIGH-ENERGY SCATTERING OF COMPOSITE HADRONS
W. Czyz Feb. 1969 60 p refs
(INP-679) Avail: CFSTI

The high-energy scattering of strongly interacting particles is discussed and illustrated mainly by high-energy nuclear scattering. Author (NSA)

N70-19482# Texas Univ., Austin. Dept. of Chemical Engineering.
BUBBLE INITIATION IN SUPER-SATURATED SOLUTIONS Final Report
D. M. Himmelblau 8 Apr. 1969 78 p refs
(Contract AT(40-1)-3326)
(ORO-3326-1) Avail: CFSTI

The effects of radioactive particles, surface characteristics, and the radius of curvature of the nucleating particles on bubble nucleation were studied in supersaturated solutions of CO2 and water. To study the effects of radioactive particles on bubble nucleation, various energies of radioactive particles were passed through supersaturated solutions to determine if they caused any difference in the previously observed bubble nucleation process. Surface characteristic effects were studied by observing differences in the amount of supersaturation necessary to cause bubble nucleation on particles of the same size but different surfaces. Particles compared were polystyrene beads with bacterial spores and polystyrene beads with glass beads. The effects of the radius of curvature were studied by observing differences in the amount of supersaturation necessary to cause bubble initiation on identical spherical particles of different sizes. NSA

N70-19483# California Univ., Berkeley. Lawrence Radiation Lab.
PHYSICS Semiannual Report, Nov. 1968-Apr. 1969
David L. Judd May 1969 166 p refs
(Contract W-7405-eng-48)
(UCRL-18877) Avail: CFSTI

A report on experimental and theoretical high-energy physics at the Lawrence Radiation Laboratory is given. Also nuclear physics, plasma physics, atomic physics, accelerator theory, health physics, mathematics and computing, and accelerator operation and development are covered. The period from November, 1968, to April, 1969, is covered. NSA

N70-19484# California Univ., Livermore. Lawrence Radiation Lab.
IRRADIATION STUDIES OF URANIUM NITRIDE
E. D. Albrecht, A. J. Rothman, J. D. Lee, J. M. Johnson, and W. N. Hayes, Jr. 15 Aug. 1969 36 p refs Presented at Natl. Symp. on Develop. in Irradiation Testing Technol., Sandusky, Ohio, 9-11 Sep. 1969 Submitted for publication Sponsored by AEC
(UCRL-71703; Conf-690910-4) Avail: CFSTI

A fission-heated, gas-bonded, binary gas controlled irradiation capsule containing eight uranium nitride specimens has been irradiated at 1307 to 1417 C during the irradiation at an average burn-up of 2.3 x 10 to the 20th power fissions/cc. There are two specimens each of four different microstructures. Neutron radiographs were made of the capsule before irradiation and at the conclusion of each cycle, in an attempt to acquire progressive swelling data during the irradiation. An extensive post-irradiation examination was made which included measurements of lengths, inside diameters, outside diameters, density, metallographic parameters, composition, and determination of uranium burn-up. Retained fission gas analyses by mass spectrometric techniques have shown that nearly 100% of the fission gas generated has been retained in each specimen, regardless of microstructure. Author (NSA)

N70-19488# Stanford Linear Accelerator Center, Calif.
LINEAR ION ACCELERATOR WITH SPATIALLY UNIFORM HARD FOCUSING [LINEINII USKORITEL' IONOV S PROSTRANSTVENNO-ODNORODNOI ZHESTKOI FOKUSIROVKOI]
I. M. Kapchinskii et al [1969] 17 p refs Transl. into ENGLISH from report ITEP-673 of the Inst. of Theoret. Phys., USSR State Comm. on Util. of Atomic Energy (Moscow), Mar. 1969 16 p
(SLAC-Trans-99; ITEP-673) Avail: CFSTI

An ion linear accelerator in which the focusing and acceleration are achieved with a high-frequency electric field produced by a long four-conductor line is proposed. The accelerator contains no drift tubes. The advantages of this accelerator are its relative simplicity of design, small transverse dimensions, and possibility of substantially reducing the injection energy while maintaining the accelerated beam at a high intensity. Author (NSA)

N70-19490# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
QUANTUM STRUCTURE OF THE MEAN-SQUARE TRANSVERSE MOMENTA OF PROTONS IN THE HIGH-ENERGY ELASTIC COLLISIONS
K. D. Tolstov 1969 9 p refs In RUSSIAN
(JINR-P1-4666) Avail: CFSTI

It is shown that in the elastic p-p scattering at high energies the differential cross sections can be expressed by a formula obtained on the basis of interference of the waves connected with the discrete values of the mean-square transverse momenta. Author (NSA)

N70-19491# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
KAON PION INTERACTION AT LOW ENERGIES
P. S. Isaev 1969 20 p refs In RUSSIAN
(JINR-P2-4375) Avail: CFSTI

Dispersion relations for s- and p-waves of kaon pion-scattering were obtained with the account of the short-wave repulsion according to the Shirkov-Serebryakov method. The solutions for the partial waves are constructed in accordance with the available data on kaon pion-interaction. If there exists a K-meson with a mass of about 1100 MeV and quantum numbers Jp = 0(+), its width is predicted to be approximately 350-400 MeV. The boundary of applicability of static approximation is estimated. Author (NSA)

N70-19492# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUM RULES FOR NEUTRAL rho, omega, phi MESON LEPTONIC DECAYS IN BROKEN SU(3) SYMMETRY
S. B. Gerasimov 1969 14 p refs In RUSSIAN
(JINR-P2-4522) Avail: CFSTI

The relations between the neutral rho, omega, psi-meson leptonic decay widths are discussed under various assumptions on the SU(3) breaking and omega-psi mixing. The results are compared with the positive electron colliding beam data. Author (NSA)

N70-19493# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
WEAK-ELECTROMAGNETIC KAON-MESON DECAYS
E. I. Maltsev 1969 16 p refs In RUSSIAN
(JINR-P1-4557) Avail: CFSTI

The properties of weak-electromagnetic K-meson decays are analyzed in detail. The results of the first stage experiments of such transitions are discussed. Author (NSA)

N70-19494# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
NEW LEVELS OF Bi 204 FROM THE alpha-DECAY OF At 208
N. A. Golovkov, R. B. Ivanov, Yu. V. Norseev, and V. G. Chumin 1969 9 p refs In RUSSIAN
(JINR-P6-4615) Avail: CFSTI

The alpha-decay of At-208 was investigated using a magnetic alpha-spectrometer. Besides the main alpha-transition three new transitions to the B-204 excited levels were observed. The energies of observed alpha-groups are given as well as their relative intensities and partial half-lives. On the basis of the available data the following excited levels of Bi-204 nucleus were introduced: 15, 56, 136 keV. Author (NSA)

N70-19496# Maryland Univ., College Park. Dept. of Physics and Astronomy.
THEORETICAL STUDIES IN NUCLEAR REACTIONS AND STRUCTURE Progress Report, 1 Jan.-30 Sep. 1969
Sep. 1969 18 p refs
(Contract AT(40-1)-3765)
(ORO-3765-22) Avail: CFSTI

Hartree-Fock and shell model studies of nuclear structure continued and several quantitative applications to specific nuclei were completed. Study of the nuclear many-body problem intensified. In the area of reaction theory, the unified shell model theory found detailed application to several nuclei and further study of analog resonances in this framework was completed. The effort devoted to reactions involving elementary particles grew last year, as did the attention paid to a variety of three-body reaction problems. The possible role of rapid collective motion as a determinant for nuclear fission was further clarified. Author (NSA)

N70-19499# Gulf General Atomic, San Diego, Calif.
NEUTRON ATTENUATION IN SOME SELECTED NONHYDROGENOUS MEDIA
C. A. Goetzmann 28 Aug. 1969 46 p refs
(Contract AT(04-3)-167)
(GA-9438) Avail: CFSTI

Transport calculations using the 1DF code in a P3-S16 mode were performed to describe the neutron attenuation in nonhydrogeneous media such as carbon, aluminum, iron, lead, and dry sand. One dimensional calculations were done for slab shields placed adjacent to a slab volume source containing a uniform distribution of fission sources. Twenty six energy groups were employed to represent the neutron spectrum over the entire range from thermal to fission energies. Results are presented as plots of the relative attenuation of flux and dose rate as a function of shield thickness. Some comparisons are made with other published data. Neutron buildup factors defined by analogy to gamma ray theory are calculated and presented in graphical form. Their usefulness is discussed. Author (NSA)

N70-19500# Sandia Corp., Albuquerque, N.Mex. Spectroscopy Div.
CHARACTERIZATION OF MATERIALS BY QUALITATIVE NEUTRON ACTIVATION ANALYSIS
B. T. Kenna and P. E. Harrison Nov. 1969 12 p refs Sponsored by AEC
(SC-RR-69-568) Avail: CFSTI

The use of qualitative neutron activation analysis, which includes gamma spectrometry, is shown to be feasible for characterization of polyethylene and aluminum alloy systems. These two diverse matrix systems were chosen to demonstrate the generality of the approach. The gamma spectrum arising from the radioelements produced can be unique since particular elements are present in a sample in specific quantities. The full utilization of the method can be realized when various factors concerning the production and counting of the radionuclides are maximized. In addition, comparison of photopeak intensity ratios increases the usefulness of the method. Author (NSA)

N70-19504# Du Pont de Nemours (E. I.) and Co., Aiken, S. C.
FORECASTING OF CF-252 PRODUCTION VIA A SIMULATION MODEL
F. Delano Knight, Ronald P. Christman, and Catherine R. Thorn Oct. 1969 30 p refs
(Contract AT(07-2)-1)
(DP-1151) Avail: CFSTI

A computer program, CALICO, has been designed and written for the forecasting of Cf-252 production. This program provides estimates for Cf-252 and secondary products by simulating the interactions between a dual reactor system, a chemical separations plant, and a target fabrication facility. CALICO was written in FORTRAN IV for a 256 k IBM System/360-65 with a 2314 Direct Access Storage device. Author (NSA)

N70-19515# Central Lab. for Radiological Protection, Warsaw (Poland).
EXTRAPOLATION IONIZATION CHAMBER
J. Roman and B. Sawicka 1969 15 p refs In POLISH
(CLOR-74) Avail: CFSTI

Construction and operation of a variable-spacing parallel-plate ionization chamber are described. It has been designed mainly for the measurement of beta dose rate. This chamber allowed measurement of beta dose rate in the range from few tenths of rad/h to several hundreds of rad/h with an accuracy of 10%. Author (NSA)

N70-19518# TRI-Univ. Meson Facility, Vancouver (British Columbia).
ENERGY RESOLUTION IN A 500 MeV H(-) CYCLOTRON
J. Reginald Richardson Jun. 1969 22 p
(TRI-69-6) Avail: CFSTI

The energy resolution to be expected from a 500 MeV H(-) cyclotron is described for the following four cases: energy

resolution of the raw beam, with no selection process in the cyclotron, energy resolution with low energy defining slits to limit the amplitude of radial oscillations, separated turn acceleration and extraction, and selection of energy by determining three points on the final orbits. NSA

N70-19520# California Univ., Berkeley. Lawrence Radiation Lab.
KAON MASS MEASUREMENT FROM KAONIC ATOM X-RAYS
Raymond Kunselman and Clyde E. Wiegand 9 Sep. 1969 8 p refs Presented at Intern. Conf. on Hypernucl. Phys., Argonne, Ill.
(Contract W-7405-eng-48)
(UCRL-19251; Conf-690503-6) Avail: CFSTI

Measurements on several X-ray transitions of kaonic atoms are presented. Preliminary results of a determination of the mass of mesons (K-) from the difference in energy between two atomic energy levels are given. The data are taken from previous work. The measured values of the meson (K-) mass are listed and plotted, and the weighted average is found to be 493.97 + or - 0.22 MeV. It is noted that this method is not statistically as accurate as the emulsion method, but it can be improved. NSA

N70-19521# Scientific Translation Service, Ann Arbor, Mich.
INELASTIC INTERACTIONS OF HIGH-ENERGY PROTONS WITH ATOMIC NUCLEI
V. S. Barashenkov et al [1969] 15 p refs Transl. into ENGLISH from Joint Inst. for Nuclear Research, Dubna (USSR) report JINR-P2-4402 Sponsored by AEC Prepared for Oak Ridge Natl. Lab.
(ORNL-tr-2200; JINR-P2-4402) Avail: CFSTI

The Monte-Carlo method is used to calculate the intranuclear cascades initiated by protons of an energy from a few dozens of MeV to about 30 GeV. The law of energy-momentum conservation and the meson production processes are exactly taken into account. The evaporation from excited residue-nuclei is calculated. In the whole energy range from a few dozens of MeV to about 5 GeV the results of calculations are in good agreement with experiment; at higher energies there appear noticeable discrepancies in the characteristics of the low-energy component of produced particles. These discrepancies grow with increasing energy of the primary nucleon. An analogous disagreement between the experimental results and those obtained by the usual cascade theory appears in the case of pion-nuclear interactions. Author (NSA)

N70-19522# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ANALYSIS OF THE SPIRAL AND SPIN AMPLITUDES IN THE REACTION PION (+) p YIELDS N*(++) RHO MESON (0)
N. Angelov, I. M. Gramenitskii, Kh. Kanazirski et al 1969 10 p refs In RUSSIAN
(JINR-P1-4668) Avail: CFSTI

An analysis of the angular distributions of the resonance decay products was made with the aid of the helicity amplitudes in reaction positive pion proton yields N*(++) rho meson (0) at 2.34 GeV c. It is shown that at small angles of the resonance production theta (s) only one amplitude R(+) = (1/2(0 R 1/2) makes the main contribution to the process considered. Author (NSA)

N70-19523# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy
ESTIMATE OF THE ADMIXTURE TO THE n p YIELDS p p PION(-) REACTION AT A NEUTRON MOMENTUM FROM 2 TO 10 GeV/c
A. P. Gasparyan, A. V. Nikitin, and Yu. A. Troyan 1969 20 p refs In RUSSIAN
(JINR-P1-4642) Avail: CFSTI

On the basis of the background available experimental data and simulation of the investigated and background reactions the admixture to the neutron proton yields proton proton negative pion reaction was estimated when bombarding the 50-cm propane chamber by neutrons with the momentum from 2 to 10 GeV/c. The admixture is shown to be not more than (6-14%) by the mentioned system of data processing. Author (NSA)

N70-19525# European Organization for Nuclear Research, Geneva (Switzerland).
EQUIVALENCE OF SUM RULES FOR K SUB L-K SUB S DECAY
G. C. Wick (Columbia Univ.) 12 Aug. 1969 7 p refs Sponsored in part by AEC
(NYO-1932(2)-156) Avail: CFSTI

It is shown that the standard Lee-Oehme-Yang treatment and the S matrix approach for sum rules for K2-K1 decay are entirely equivalent. Specifically it is shown that the sum rules agree completely, the standard method when applied to the S matrix problem yields all the results of the pure S matrix approach, and one can proceed conversely from the pure S matrix formulas back to all the results of the usual treatment. NSA

N70-19526# Douglas United Nuclear, Inc., Richland, Wash.
SUPPLEMENTAL NOTES ON THE COMPUTER CODE ALCHEMY 2
A. F. Kupinski 1 Sep. 1969 26 p refs
(Contract AT(45-1)-1857)
(DUN-6065) Avail: CFSTI

The ALCHEMY-2 computer program for the UNIVAC is described. The computer program solves the vector differential equation representation of time dependent isotopic buildup and depletion. NSA

N70-19527# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
NONADIABATIC ROTATIONAL MODEL FOR TWO STRONGLY-COUPLED BANDS IN ODD-MASS NUCLEI
N. I. Pyatov and M. I. Chernei 1969 23 p refs In RUSSIAN
(JINR-P4-4533) Avail: CFSTI

The nonadiabatic rotational model proposed by Kerman was extended to take into account the pairing force and the effect of the Coriolis coupling on the energy gap and chemical potential. Utilizing the variational method equations for energy gap, chemical potential and rotational energy are derived which include the blocking effect as well. The coupling between quasi-particles and pairing vibrations of the core was treated with the RPA method. The effects of this coupling are included in the equations for energy gap and chemical potential. Author (NSA)

N70-19528# Scientific Translation Service, Ann Arbor, Mich.
CALCULATION OF THE RADIATION DOSE IN THE INTERIOR OF A SATELLITE WITH CONSIDERATION OF THE STRUCTURE OF THE SATELLITE AND THE ANGULAR DISTRIBUTION OF THE RADIATION
K. Wohlleben et al [1969] 29 p refs Transl. into ENGLISH from Bundesministerium fuer Wiss. Forsch. research report BMwF-FB-W-69-03 Sponsored by AEC Prepared for Oak Ridge Natl. Lab.
(ORNL-tr-2201; BMWF-FB-W-69-03) Avail: CFSTI

A method is described for calculating the radiation dose rate inside a defined satellite structure when the dose rate is a known function of the radiation shield thickness. The possibilities of isotropic and anisotropic radiation are covered. The ALGOL program SATSTRUKTUR, based on this method, is described. This program can be used for calculating the radiation dose rate for symmetric-axis satellite structures of random configuration and rotation-symmetric pitch angle distribution. Results of the dose-rate calculations for the AZUR satellite are given. Author (NSA)

N70-19532# Mound Lab., Miamisburg, Ohio.
STABLE GASEOUS ISOTOPE SEPARATION AND PURIFICATION: JANUARY-MARCH 1969

G. R. Grove and R. E. Vallee 27 Aug. 1969 45 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1605) Avail: CFSTI

Developments are reported for studies on: carbon isotope separation; stable gaseous isotope separation, including He, Ne, Ar, Kr, Xe, and O; thermal diffusion; and low-temperature processes. NSA

N70-19533 Stanford Univ., Calif.
A STUDY OF QUASIPARTICLE-VORTEX SCATTERING IN SUPERFLUID HELIUM
William James Titus (Ph.D. Thesis) 1968 124 p
Avail: Univ. Microfilms: HC $6.00/ Microfilm $3.00 Order No. 69-8285

The scattering of quasiparticles (phonons, rotons, and He-3 impurities) from a quantized, rectilinear vortex in superfluid helium uses the Lippmann-Schwinger equations of quantum mechanics. The prime assumption in this formalism is that a quasiparticle behaves like a stable point particle with a well-defined energy-momentum dispersion relation and that the vortex velocity has translational and rotational invariance along and about the z axis of some cylindrical coordinate system (r, phi, z). The main disadvantage in using the Lippmann-Schwinger formalism is the need to assume some form for the scattering potential which acts between a quasiparticle with momentum and energy and a vortex with velocity. Dissert. Abstr.

N70-19538# Columbia Univ., Irvington, N.Y. Nevis Labs.
NEUTRON EMISSION FROM MUON CAPTURE
Martin H. Krieger (Ph.D. Thesis) Apr. 1969 82 p refs
(Contract AT(30-1)-1932)
(CU-276; R-669; NEVIS-172) Avail: CFSTI

A high resolution measurement of the neutron energy spectrum from muon capture in calcium, sulfur and lead was performed. A unique spark chamber-scintillator neutron detector was used which gives a direct measurement of the neutron energy. The energy spectra fall off appxoximately exponentially between 10 and 40 MeV. The adequacy of current nuclear models for explaining these results is explored. Author (NSA)

N70-19540# Brookhaven National Lab., Upton, N.Y. Information Div.
CORRELATION FUNCTIONS FOR NUCLEAR MATTER
G. F. Filippov et al 1969 12 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Inst. Teor. Fiz. (Kiev) report ITF-69-18, 1969 Sponsored by AEC
(BNL-tr-289; ITF-69-18) Avail: CFSTI

Nuclear matter is considered as an infinite lattice of the nucleon system. The correlation function for such a model of nuclear matter is built up and calculated. The correlation function is also calculated for the shell model of nuclear matter with one-particle oscillator functions being used. A comparison of the correlation functions of the two models is made. Author (NSA)

N70-19543# Chalmers Univ. of Technology, Goteborg (Sweden). Inst. for Reaktorfysik.
PULSED NEUTRON METHOD APPLIED TO THE INTERACTION BETWEEN TWO MODERATORS
Gudmar Grosshoeg Jul. 1969 49 p refs
(CTH-RF-17) Avail: CFSTI

The possibility to use the pulsed neutron method in the study of two interacting moderators was investigated. It was found both through theory and experiments that transport effects have a dominant influence on the decay constants. The decay constants were measured in a system consisting of two polyethylene discs separated along the symmetry axis. The discs had a diameter of 18 cm. Two series were measured. In the first the discs had a height of 2.2 cm. They were separated by a distance that was varied up to 13.2 cm in steps of 2.2 cm. In the second the height of the discs was 4.4 cm, the maximum separation distance was 8.8 cm, and the step length was the same as in the first series. Reliability of the measurement was checked in the limit of zero separation distance and in the limit of no interaction. Dissert Abstr.

N70-19550# Stanford Linear Accelerator Center, Calif.
MUON PAIR PRODUCTION IN STRONG INTERACTIONS AND THE ASYMPTOTIC SUM RULES [ROZHDENIYE MYUONNYKH PAR V SIL'NYKH VZAIMODEYSTVIYAKH: ASIMPTOTICHESKIYE PRAVILA SUMM]
V. A. Matveev et al 1969 27 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res., Dubna (USSR) report JINR-P2-4543, 1969 23 p
(SLAC-Trans-98; JINR-P2-4543) Avail: CFSTI

Meson pair production for highly inelastic interactions between a hadron and a proton at high energies which results in the production of a meson (muon) pair and a system and of hadrons is studied. It is shown that at high energies and momentum transfers the form factors for this process are related to the matric elements of equal-time electromagnetic current commutators. The asymptotic sum rules obtained can be used as a basis for verifying the structure of the electromagnetic hadron current. The predictions of the quark current algebra and field algebra for the muon polarization turn out to be qualitatively different. Studies of meson (muon) polarization in this process are also essential for the analysis of experiments using polarized muon detection at large angles. NSA

N70-19573# California Univ., Berkeley. Lawrence Radiation Lab.
NONLEPTONIC DECAY OF SIGMA HYPERONS
Roger Odell Bangerter (Ph.D. Thesis) 7 Jul. 1969 96 p refs
(Contract W-7405-eng-48)
(UCRL-19244) Avail: CFSTI

Measurements of decay parameters are presented for negative Sigma hyperon yields n negative pion, positive Sigma hyperon yields p neutral pion, and positive Sigma hyperon yields n positive pion. Polarized positive or negative Sigma hyperons are produced by the reaction negative kaon p yields positive or negative Sigma hyperons negative or positive pions inthe 25-inch hydrogen bubble chamber. The average momentum of the incident negative kaon beam is 385 MeV/c. The measurements of alpha parameters are performed by observing the up-down asymmetry in the Sigma hyperon decay distributions, and the measurements of phi parameters are made by observing the left-right asymmetry in the np interactions of those decay neutrons that subsequently scattered on the hydrogen in the bubble chamber. Author (NSA)

N70-19574# TRI-Univ. Meson Facility, Vancouver (British Columbia).
POLARIZATION MEASUREMENTS FOR p, p YIELDS PION(+) D
D. S. Beder (British Columbia, Univ.) Apr. 1969 16 p refs
(TRI-69-4) Avail: CFSTI

How polarization experiments on pp yields pion can provide information on the transition amplitudes relevant near the reaction threshold energy is discussed. Author (NSA)

N70-19577# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
STOCHASTIC INTERPRETATION OF THE ELASTIC SCATTERING PROCESS AT HIGH ENERGIES IN CASE OF SMEARED WAVE PACKETS
A. V. Shurgaya 1969 16 p refs In RUSSIAN
(JINR-P2-4565) Avail: CFSTI

It is supposed that the momentum distribution in the intermediate states of the elastic scattering is described by a stable law with the characteristic $0 < a < 2$. The contribution of the highest intermediate states to the imaginary part of the scattering

amplitude is calculated. It is shown that the scattering amplitude in this case is a degree function of the momentum transfer.
Author (NSA)

N70-19581# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
MULTIPLETS AT 4.10 AND 4.44 MeV OF EXCITATION IN Ca 42 [MULTIPLETS A 4.10 ET 4.44 MeV D'EXCITATION DANS Ca 42]
A. Tellez, R. Ballini, J. Delaunay, and J. P. Fouan [1969] 1 p refs In FRENCH Presented at Intern. Conf. on Properties of Nucl. States, Montreal, Can., 25-30 Aug. 1969
(CEA-CONF-1328; CONF-690804-13) Avail: CFSTI

The reactions Ca-42(p,p(prime)gamma) Ca-42 and K-41(He-3,d gamma) Ca-42 were studied at incident energies of 12 and 18 MeV, respectively. The (He-3,d) measurement showed the four levels T = 2 of the proton configuration at the energies of 9.75, 9.85, 10.00, and 10.45 MeV. The T = 2 levels are deexcited principally toward the T = 1 levels of the same configuration. The multiparametric recording and the bidimensional analysis of the coincidences of the (p,p(prime)gamma) measure showed a doublet and a triplet existing at 4.10 and 4.44 MeV. The deexcitation schemes of the members of these multiplets and the spins and parities attributed to them by taking into consideration those established at these energies by different reactions are tabulated.
NSA

N70-19588# Columbia Univ., Irvington, N.Y. Nevis Labs.
SIGMA LEPTONIC BRANCHING RATIOS
Herbert Norton (Ph.D. Thesis) May 1969 70 p refs
(Contract AT(30-1)-1932)
(CU-279; R-672; NEVIS-175) Avail: CFSTI

An exposure of 550,000 pictures of negative kaon, stopping in hydrogen, was scanned for obvious Sigma leptonic decays. The film contained 2.1 x 1 million negative Sigma hyperons and 1.0 x 1 million positive Sigma hyperons produced by the reactions negative kaon p yields positive on negative Sigma hyperons negative or positive kaons. Results are given in ratios which agree within errors with the ratios measure by other groups. Averaging the data with the world data and using some other measurements, a fit is obtained to Cabibbo theory.
Author (NSA)

N70-19590# California Univ., Berkeley. Lawrence Radiation Lab.
GLOSSARY FOR REGGE POLE THEORY
J. D. Jackson 24 Sep. 1969 23 p refs
(Contract W-7405-eng-48)
(UCRL-19351) Avail: CFSTI

A glossary is presented for Regge pole theory for the use of readers of papers in this area of high energy theoretical physics. Definitions of invariant amplitudes and t-channel helicity amplitudes for meson-baryon elastic scattering and photo-production of pions, as well as the connection between crossing symmetry and signature and a list of Regge trajectories are given.
Author (NSA)

N70-19591# Brookhaven National Lab., Upton, N.Y.
QUASIELASTIC SCATTERING OF 665-MeV PROTONS BY ALPHA-PARTICLE CLUSTERS IN LIGHT NUCLEI
V. I. Komarov et al 1968 17 p refs Transl. into ENGLISH from a RUSSIAN Report no. JINR-P1-4227
(BNL-TR-282; JINR-P1-4227) Avail: CFSTI

The cross sections for knocking out He-4 nuclei with energy about 470 MeV from Li-6, Be-9, C-12 targets at 5.4 deg to a 665-MeV proton beam were measured. He-4 nuclei were identified by the effective momentum, time-of-flight, specific energy loss, total energy loss, and range. The peak in the momentum spectrum of He-4 nuclei was observed which is caused by the quasielastic scattering of protons by the intranuclear alpha-cluster with 9.5 fermi(-1) momentum transfer to the alpha particle. The comparison of cross sections obtained for quasielastic scattering with the cross section of elastic proton scattering measured in the same conditions gives the effective numbers of alpha clusters in the investigated nuclei. The results obtained confirm the correctness of basic ideas on quasielastic knocking out of high-energy He-4 by fast protons from light nuclei and, in particular, show the proximity of internal structure of the alpha-cluster and free He-4 nuclei at small relative distances.
Author (NSA)

N70-19592# Oak Ridge National Lab., Tenn.
ISOTOPE USER'S GUIDE
F. E. Mc Kinney, S. A. Reynolds, and P. S. Baker Sep. 1969 96 p refs
(Contract W-7405-eng-26)
(ORNL-IIC-19) Avail: CFSTI

Approximately 200 commercially available radioisotopes are listed, with their radiations and production methods included. Definitions associated with physics used with radioisotopes are provided. Assistance in choosing an isotope for a specific use, shipping information, and special irradiation services are given. The stable isotope list includes nearly all of the existing nonradioactive isotopes, since they have been enriched. An extensive list of available radioisotopes with principal characteristics is included.
NSA

N70-19593# Princeton Univ., N.J. Dept. of Physics.
THE n + p YIELDS d + gamma: A TEST OF TIME REVERSAL INVARIANCE
Carl E. Friedberg (Ph.D. Thesis) 10 Sep. 1969 157 p refs
(Contracts N00014-67-A-0151-0001; AT(30-1)-2137; Grants NSF GJ-34; NSF GU-3157)
(PURC-2137-13; TR-5) Avail: CFSTI

The process n + p yields d + gamma was investigated at the Princeton Pennsylvania Accelerator as a test of time reversal invariance. The differential and total cross sections obtained were compared with those for the process gamma + d yields n + p, as a test of reciprocity, for neutron energies between 160 and 640 MeV. The total cross sections measured are in agreement with existing data. The differential cross sections measured are in agreement except in the energy range 520 < Tn < 640 MeV.
Author (NSA)

N70-19599# Institute of Nuclear Research, Warsaw (Poland).
ENERGY DEPENDENCE OF THE POLARIZATION IN DIRECT REACTION
M. Kozlowski 1969 14 p refs
(INR-1094) Avail: CFSTI

An analysis is made of the polarization of protons from the reaction Be-9(d,p)Be-10. It is shown that the predictions based on the invariance of the density matrix under the exchanging of the distorted waves are in the qualitative agreement with the experimental data. The usefulness of the DWBA for the describing of the polarization in the energy range 2 to 10 MeV is also discussed.
Author (NSA)

N70-19607# Stanford Linear Accelerator Center, Calif.
FORMATION AND DECAY OF POSITIVE NEGATIVE MUON ATOMS [OBRAZOVANIE I RASPAD POSITIVE NEGATIVE MUON ATOMOV]
S. M. Bilenkii et al 1969 6 p refs Transl. into ENGLISH from report JINR-P2-4438, Dubna (USSR), 1968 6 p Submitted for publication
(SLAC-Trans-97; JINR-P2-4438) Avail: CFSTI

The production of (positive muon negative muon) atoms in particle collisions negative pion + p yields (positive muon + negative muon) + n and gamma + Z yields (positive muon + negative muon) + Z is studied. The cross sections for these

N70-19608# Princeton Univ., N.J.
QED EXPERIMENTS WITH MUONS
K. W. Chen [1969] 15 p refs

(Contract AT(30-1)-2137)
(PURC-2137-14) Avail: CFSTI

The muon experiments primarily studying quantum electrodynamics (QED) at small distances or muon-e differences are considered. Several of these experiments appear attractive without regard to the storage-ring considerations. The quality of muon beam required and sensitivity of the experiment to QED breakdown are presented. Author (NSA)

N70-19609# Oak Ridge National Lab., Tenn. Neutron Physics Div.
ELECTROMAGNETIC AND NUCLEAR-CASCADE CALCULATIONS AND THEIR APPLICATION IN SHIELDING AND DOSIMETRY
R. G. Alsmiller, Jr. 15 Oct. 1969 27 p refs Presented at 2nd Intern. Conf. on Accelerator Dosimetry and Experience, Stanford, Calif., 3-5 Nov. 1969 Sponsored by AEC
(ORNL-TM-2722; CONF-691101-4) Avail: CFSTI

A review paper on recent high-energy accelerator shielding calculations is presented. The subjects considered are electron-photon cascades, photonucleon and photopion production, nucleon-meson cascades, and muon transport. Calculated results are presented and compared with experimental data in each of these categories. Author (NSA)

N70-19611# Brookhaven National Lab., Upton, N.Y.
KNOCK-OUT OF FAST He 3 FRAGMENTS FROM LIGHT NUCLEI BY 665-MEV PROTONS
V. I. Komarov et al 1969 20 p refs Transl. into ENGLISH from a Russian Report, no. JINR-P1-4373
(BNL-TR-281; JINR-P1-4373) Avail: CFSTI

The cross sections for knocking out fast 530 MeV He-3 nuclei from Li-6, Be-9, C-12 targets at 5.4 deg to the 665 MeV proton beam were measured. The peak in the high energy part of the He-3 momentum spectrum was observed which is due to the quasielastic scattering of protons on three nucleon clusters in the investigated nuclei. The cross sections of such scattering causing the He-3 knockout from Li-6, Be-9 (and the upper limit for C-12, O-16) were evaluated. Also the differential cross section of elastic scattering of protons on free He-3 nuclei was measured. The measurements were performed as a part of the program of experimental investigations of high-energy proton interactions with nuclei resulting in the high momentum transfer to a few nucleon system without its disintegration. Author (NSA)

N70-19613# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SPECTROSCOPY OF THE NUCLEUS N -82 WITH THE AID OF THE REACTIONS (p,d) AND (p,t) AT 24.55 MeV [SPECTROSCOPIE DES NOYAUX N -82 A L'AIDE DES REACTIONS (P,D) ET (P,T) AT 24.55 MEV]
G. Bruge, A. Chaumeaux, Ha-Duc Long, and J. Picard [1969] 1 p In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969
(CEA-CONF-1325; CONF-690804-5) Avail: CFSTI

The 1- and 2-hole neutron states were studied in Ba-138, Ce-140, Nd-142, and Sm-144. The angular distributions relative to the excited state of the residual nucleus were compared for the 1-hole states with the DWBA predictions. Transferred angular moments 1, 0, 2, 4, and 5 were obtained corresponding to the orbits 3s1/2, 2d3/2 or 2d5/2, and 1h11/2. The results are tabulated. The angular distributions of the tritons are under analysis. NSA

N70-19614# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
COLLECTIVE ION ACCELERATOR AND HEAVY IONS [L'ACCELERATEUR COLLECTIF D'IONS ET LES IONS LOURDS]
H. Bruck [1969] 8 p refs In FRENCH Presented at the Conf. on the Phys. and Production of Heavy Ions, La Plagne, France, 17-21 Mar. 1969
(CEA-CONF-1286; CONF-690314-4) Avail: CFSTI

The entrainment of ions by the collective field of a cloud of accelerated electrons is designated as collective ion acceleration. The application of this concept to the acceleration of heavy ions is considered. The characteristics of a heavy ion collective accelerator are derived. NSA

N70-19615# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nuclear.
STUDY OF THE REACTIONS (p,d) ON THE NUCLEI OF Fe 57, W 61, Zr 91 BY MEANS OF POLARIZED PROTONS [ETUDE DES REACTIONS (p,d) SUR LES NOYAUX DE FE 57, NI 61, ZR 91 AU MOYEN DE PROTONS POLARISES]
L. Escudie, J. C. Faivre, J. M. Gosset, R.M. Lombard, B. Mayer et al [1969] 1 p refs In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969 Prepared in cooperation with Inst. of Phys. and Chem. Res.
(CEA-CONF-1332; CONF-690804-10) Avail: CFSTI

The cross sections and the asymmetries from 15 to about 150 deg, were measured for the reactions Ni-61(p,d)Ni-60(1 sub n = 1, j sub n = 3/2) at 16.6 MeV, Fe-57(p,d)F3-56 (1 sub n = 1, j sub n = 1/2, Fe-57(p,d)Fe-56*(2(+), E sub x = 0.847 MeV) at 17.3 MeV, and Zr-91(p,d)Zr-90(1 sub n = 2, j sub n = 3/2) at 24.5 MeV. The cross sections and polarizations for the elastic scattering of protons on these nuclei were measured simultaneously. Optical potentials, taking into account the experimental data, were determined for DWBA calculations. The cross section for the Fe-57(p,d)Fe*-56 reaction is much better reproduced with an equal mixture of 1 sub n = 1, j sub n = 3/2 and 1 sub n = 3, j sub n = 5/2 than with pure a sub n = 1. The asymmetry is also described better by this mixture, but much less significantly. NSA

N70-19616# Australian Atomic Energy Commission, Coogee.
[ORGANIZATION AND RESEARCH PROGRAMS Annual Report, 1968–1969]
30 Jun. 1969 115 p refs
(NP-18051; AR-17) Avail: CFSTI

The organization and research programs of the Australian Atomic Energy Commission for 1968-69 are described. Topics covered include nuclear power, raw materials, research programs in reactors, reactor chemistry, nuclear radiation detectors, radiochemistry and radiation biology; and production of radioisotopes. Peaceful uses of nuclear explosives and regulatory aspects of nuclear energy are also mentioned. Financial accounts, research and training projects, and other administrative matters are outlined. NSA

N70-19624# Princeton-Pennsylvania Accelerator, Princeton, N.J.
NEUTRON-PROTON CHARGE-EXCHANGE SCATTERING BETWEEN 600 MeV/c AND 2000 MeV/c
P. F. Shepard (Ph.D. Thesis -Princeton Univ.), T. J. Devlin, R. E. Mischke, and J. Solomon Mar. 1969 139 p refs
(Contract AT(30-1)-2137)
(PPAR-10) Avail: CFSTI

N-p elastic differential cross sections in the charge-exchange region were measured for incident neutron momenta between 600 MeV/c and 2000 MeV/c. A secondary neutron beam from the bombardment of a 1 1/2-in. platinum target by the 3-GeV internal proton beam at the Princeton-Pennsylvania Accelerator was scattered from a liquid-hydrogen target. The incident neutron energy was determined by a measurement of flight time over a 108 ft. flight path. The momentum and scattering angle of the recoil proton were measured by a wire-spark-chamber magnetic spectrometer with magnetostrictive readout. Approximately 450,000 elastic events were detected for proton laboratory angles between 0 and 62 deg. Differential cross sections are presented at fifteen energies. An absolute normalization of the cross sections was achieved by measuring the incident neutron flux with a detector whose efficiency was determined experimentally. Author (NSA)

N70-19625# Minnesota Univ., Minneapolis. School of Physics.
THEORETICAL AND HIGH ENERGY PHYSICS PROGRAMS
Progress Report, 1 Sep. 1968-31 Aug. 1969
Y. C. Tang et al Aug. 1969 54 p refs
(Contract AT(11-1)-1764)
(COO-1764-39) Avail: CFSTI

Research at the University of Minnesota on theoretical nuclear physics and theoretical and experimental elementary particle physics from September, 1968, to August, 1969 is summarized. A list of publications is also included. NSA

N70-19628# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
PHILLIPS SOURCE [SOURCE PHILLIPS]
P. A. Chamouard 12 May 1969 18 p In FRENCH Presented at Intern. Conf. on Ion Sources, Saclay, France, 18-20 Jun. 1969
(CEA-CONF-1385; CONF-690625-6) Avail: CFSTI

The discussion of the Phillips ion source covers the characteristics of the beam delivered by the source, description and assembling of the source, installation of the vacuum system, operation as a deuteron source, and testing of a point source. NSA

N70-19631# California Univ., Livermore. Lawrence Radiation Lab.
STATISTICAL THEORY OF DESIGN FOR PLATING THICKNESS MEASUREMENTS BY RADIATION BACKSCATTER METHODS
Jerry D. Fox and Grover M. Taylor 1 Jul. 1969 35 p refs Presented at the 29th Natl. Conv. on Am. Soc. for Nondestructive Testing, Philadelphia, 13-16 Oct. 1969 Sponsored by AEC
(UCRL-71605-Rev-1; CONF-691005-3) Avail: CFSTI

The application of statistical experimental design techniques to two methods of plating thickness measurements, X ray fluorescence and beta-radiation backscatter, is discussed. The following factors are discussed: number of standards, accuracy of standards, thickness range, and accuracy of radiation measurements for both the standard and the unknown thicknesses. A least-means-squares technique is applied for fitting the calibration curves, and analytical techniques are used to study the effect of variations in the above factors on the final uncertainty in determination of the unknown thicknesses. Tabulated experimental and theoretical data are included for guidance in designing nondestructive testing programs that use these techniques. Author (NSA)

N70-19633# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
SUPERFLUID QUARK MODEL
Yu. M. Malyuta 1969 22 p refs In RUSSIAN
(JINR-P2-4581) Avail: CFSTI

A superfluid quark model based on the Sp(6) group is suggested (a superfluid model of the Flowers, Szpikowski and Ichimura nucleus based on the Sp(4) group is the prototype of this model). In the model mentioned the hadrons are described by eigenfunctions of the Hamiltonian of superconductive type, and the eigenvalues which determine their mass spectrum. The available experimental data agree well with the model predictions. Author (NSA)

N70-19652# Columbia Univ., Irvington, N.Y. Nevis Labs.
ELECTRON-POSITRON DECAY MODEL OF VECTOR MESONS
Charles Lee Jordan (Ph.D. Thesis) Apr. 1969 78 p refs
(Contract AT(30-1)-1932) (CU-277; R-670; NEVIS-73) Avail: CFSTI

At the 6.2-GeV electron synchrotron, electron-positron pair yields were measured as a function of the invariant mass of the pair. The rho and psi mesons were identified as the sources of the pairs in excess of the quantum electrodynamics pair production yield. The omega meson contributed, at most, 10% of the pairs in the invariant mass region from 660-860 MeV/c squared. The branching ratio was calculated after measuring the rho photoproduction with the same apparatus. The resulting value for the branching ratio is .000065 + or - .000014. The measuring apparatus was a double arm symmetric magnetic spectrometer in which charged particles were detected by scintillation and Cherenkov radiation counters. The data are discussed with respect to the vector dominance model of hadronic electromagnetic interactions, muon-electron universality, and the important question of a clear determination of the width of the rho meson. Author (NSA)

N70-19653# Columbia Univ., Irvington, N.Y. Nevis Labs.
A MEASUREMENT OF THE BRANCHING RATIO (NEUTRAL eta MESON YIELDS NEUTRAL pion gamma gamma / NEUTRAL eta YIELDS ALL NEUTRAL DECAY MODES)
Stephen Shapiro May 1969 95 p refs
(Contract AT(30-1)-1932)
(CU-278; R-671; NEVIS-174) Avail: CFSTI

A spark chamber experiment to measure the branching ratio, R, was performed. The result of this measurement is R < 6% at the 88% confidence level. Negative pions of 860 MeV/c momentum were incident on a liquid hydrogen target. The target was surrounded by scintillation counters and 4 stainless steel optical spark chambers in a nearly 4 pi geometry. Neutron time of flight measurements for the reaction pion(-) + p yields X(0) + N enabled one to select events for which the invariant mass of the X(0) was that of the eta meson(0). From these events, pictures having four gamma rays were selected and measured. Then each event was kinematically fitted to two hypotheses; (A) pion(0) + p yields 2 pion(0) + N, and (B) eta meson(0) yields pion(0) gamma gamma. By normalizing the candidates for channel (B) to the candidates for channel (A), a number is obtained from which one can deduce the quantity of interest R in such a way as to minimize the dependence on Monte Carlo calculations of detection efficiencies. Author (NSA)

N70-19668# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
REACTIONS 106, 114 Cd 48(He 3,) 107, 115
M. Conjeaud, S. Harar, and E. Thuriere [1969] 1 p In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969
(CEA-CONF-1329; CONF-690804-7) Avail: CFSTI

Studies are under way to determine the properties of the first excited states of In-115. Beginning at 800 keV excitation energy numerous levels appear which are not excited by the Sn(d,He-3) reaction. The peopling of these states can be made by the transfer of a proton into the empty orbits. It does not seem necessary, as has been suggested previously, to introduce a rotational model to explain the location of these states at low excitation energy. In the reactions In-115(He-3d) the orbits 1g sub 7/2, 2d sub 5/2, ... appear toward 3.7 MeV above the ground In-115 by considering a pairing energy of about 2.8 MeV. By assuming that the spin and parity previously assigned are confirmed, the 7/2(+) level at 935 keV is very excited by the Cd-114(He-3,d) reaction with respect to the 1/2(+) and 3/2(+) levels unseparated at 828 and 864 keV and with respect to the 5/2(+) at 1078 keV which is not excited. A detailed DWBA analysis is underway both for Cd-108 and Cd-114. NSA

N70-19671# Princeton Univ., N.J. Palmer Physical Lab.
THE n + p YIELDS d + gamma AND TIME REVERSAL INVARIANCE
D. F. Bartlett, C. E. Friedberg, K. Goulianos, I. S. Hammerman, and D. P. Hutchinson (Princeton-Pennsylvania Accelerator) 6 Aug. 1969 15 p refs
(Contracts N00014-67-A-0151-0001; AT(30-1)-2137)
(PPAR-20) Avail: CFSTI

Measurements are reported of the differential and total cross section for n + p yields d + gamma for neutron energies between 160 and 640 MeV. A comparison is made with the differential and total cross sections for the inverse process.
Author (NSA)

N70-19679# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
FORM FACTOR MODELS AND CHIRAL SYMMETRY
P. H. Frampton Oct. 1969 11 p refs
(Contract AT(11-1)-264)
(EFI-69-90) Avail: CFSTI

Simple models for the vector and axial-vector form factors are examined from the point of view of their consistency with the beta function model and with the chiral properties of the vector and axial vector currents. In an infinite class of solutions for these two form factors the asymptotic power behaviors are not determined absolutely but are related through a quantization rule for the Regge trajectory intercepts. Predictions for the vector and axial-vector form factors of the nucleon are made.
Author (NSA)

N70-19680# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
REACTION Te 130(t,alpha) Sb 129
M. Conjeaud, B. Fernandez, S. Harar, E. Thuriere, M. L. Chatterjee (Inst. Rudjer Boskovic, Zagreb, Yugoslavia) et al [1969] 1 p refs In FRENCH Presented at Intern. Conf. on Properties of Nucl. States, Montreal, Can., 25-30 Aug. 1969
(CEA-CONF-1331; Conf-690804-9) Avail: CFSTI

A typical alpha spectrum measured at 50 deg from the Te-130(t,alpha)Sb-129 reaction is presented. The structure of this spectrum shows that the first excited stated from 0.064 to 0.91 MeV can be explained by the presence of two protons at the exterior of the core Z = 50 in the orbits 1g sub 7/2, 2d sub 5/2, and 3s sub 1/2. Above 2.7 MeV six peaks occur. They probably correspond to the capture of a proton in the orbits 1g sub 9/2, 2p sub 1/2, 2p sub 3/2, and 1f sub 5/2.
NSA

N70-19681# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ANALOGUE STATES OF La 140 LEVELS
G. M. Temmer (Rutgers Univ., New Brunswick, N.J.), Y. Cassagnou, P. Foissel, M. Lamehi-Rachti, C. Levi et al [1969] 1 p refs Presented at Intern. Conf. on Properties of Nucl. States, Montreal, Can., 25-30 Aug. 1969
(CEA-Conf-1322; Conf-690804-15) Avail: CFSTI

The excitation functions of proton elastic and inelastic scattering by La-139 at 9 to 12.1 MeV were measured. Resonances to the 166-keV level and four levels above 1 MeV in La-139 were observed in the inelastic scattering. There is clear evidence that a resonance at 10.27 MeV is the analog of the 1(-) 466-keV state in La-140.
NSA

N70-19682# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INVESTIGATION OF THE STATES (2p-1t) OF Si 29 BY MEANS OF THE REACTION Al 27(He 3,p) Si 29 [RECHERCHE DES ETATS (2p 1t) DE Si 29 L'AIDE DE LA REACTION Al 27(He 3,p)Si 29]
M. C. Mermaz, M.-C. Lemaire, and B. Fernandez [1969] 3 p In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969
(CEA-CONF-1334; CONF-690804-12) Avail: CFSTI

The 18-MeV He-3 ion beam at Saclay was used to study the reaction Al-17 He-3,p Si-29. The following analogous states were identified: 8.270 + or - 0.020 MeV 5/2(+), 9.634 + or - 0.030 MeV (1/2 +), 10.000 + or - 0.030 MeV, and 10.460 + or - 0.030 MeV. The angular distribution of the first T = 3/2 was calculated with a form factor corresponding to the transfer of the neutron-proton pair on the orbit 2S1/2. The good agreement between the calculated and experimental cross section suggests for this state, a strong component (1d5/2)-1(2s1/2)2. The ground state of spin 1/2+ has an angular distribution L = 2, which signifies that the proton is transferred into the 1d5/2 hole and the neutron on the orbit 2s1/2. The levels 1.273 MeV 3/2+, 2.033 MeV 5/2+, and 2.429 MeV 3/2+ have an angular distribution with the preponderant L = 0 component.
NSA

N70-19683# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
CONDITION OF PROTON PARTICLE HOLES IN THE TIN ISOTOPES 120 AND 122 [ETATS PARTICULE TROU DE PROTON DANS LES ISOTOPES 120 ET 122 DE L'ETAIN]
M. Conjeaud, B. Fernandez, S. Harar, E. Thuriere, M. L. Chatterjee (Institut Rudjer Boskovic) et al [1969] 1 p In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969 Prepared in cooperation with Inst. Rudjer Boskovic
(CEA-CONF-1330; CONF-690804-8) Avail: CFSTI

A typical spectrum from the Sb-121,-123(t,alpha)Sn-120,-122 reaction is presented. The half-height of the peaks is about 35 keV. With the exception of the ground state and the levels at 1.14 MeV (2+) and at 2.14 MeV (4+), the transitions toward the first excited levels are not very intense. Between 1.2 and 3.7 MeV none of the states excited by inelastic scattering of the proton were observed. In this excitation region the states with positive parity do not have appreciable 1p-1t component. Above 3.76 MeV some levels appear strongly excited, and probably correspond to states of the 1p-1t type. Similar results were observed in the Sb-121(t,alpha)Sn-120.
NSA

N70-19689# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
INTENSITY OF THE (2p-1t) COMPONENT IN THE EXCITED STATES OF O 17 [INTENSITE DE LA COMPOSANTE (2p 1t) DANS LES ETATS EXCITES DE O 17]
M. C. Mermaz, M. C. Lemaire, Je N. Scheurer (Bordeaux Univ.) and K. K. Seth (Northwestern Univ.) [1969] 1 p In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969 Prepared jointly with Bordeaux Univ. and Northwestern Univ.
(CEA-CONF-1333; CONF-690804-11) Avail: CFSTI

The proton angular distributions from the N-15(He-3p)O-17 reaction were measured from 5 to 70 deg. A diagram is given of the relative excitation intensities of O-17 at an angle of 15 deg. The fact that only two levels 5.71 MeV 7/2 and 7.37 MeV 5/2- are strongly excited in the first part of the spectrum are confirmation of the theoretical hypothesis that the first excited states of negative parity should have their (1p-0t), (2p-1t) configurations strongly mixed with higher order configurations. Above 7.37 MeV the 2p-1t force becomes more important in the spectrum.
NSA

N70-19690# Mound Lab., Miamisburg, Ohio.
THE USE OF THE ASSOCIATED PARTICLE METHOD FOR DETERMINING DETECTOR EFFICIENCY OF SCINTILLATION DETECTORS FOR NEUTRONS FROM THE D(d,n) He 3 REACTION
A. Greil et al [1969] 9 p refs Transl. into ENGLISH from Kernenergie (Dresden), no. 12, 1969 p 68-70
(Contract AT(33-1)-GEN-53)
(MLM-1681-tr) Avail: CFSTI

The associated particle method is described, along with the irregularities of the reaction. A surface barrier detector (50 detector) served as the He-3 detector. An SEV K14FS50 with a plastic scintillator was used for neutron analysis. Use of the associated particles method with this equipment provides an effective evaluation of the neutron detector for 2.5 MeV neutrons.
Author (NSA)

N70-19691# Mound Lab., Miamisburg, Ohio.
PROGRAM FOR CALCULATING X-RAY DIFFRACTION INTERPLANAR (d) SPACINGS WITH A PDP-8/I COMPUTER
P. W. Seabaugh and R. R. Eckstein 15 Oct. 1969 13 p
(Contract AT(33-1)-GEN-53)
(MLM-1646) Avail: CFSTI

A PDP-8/1 computer program is described, which yields interplanar spacings from measurements made on an X-ray diffraction photograph of a powdered sample of a crystalline material. Use of the small computer located in the laboratory greatly reduces the data flow-through time in comparison with that required in using a large central computer system. Author (NSA)

N70-19692# Scientific Translation Service, Ann Arbor, Mich.
DIRECT DETERMINATION OF TRANSMISSION AND REFLECTION MATRIXES FOR GAMMA RAYS
A. H. Maute [1969] 37 p refs Transl. into ENGLISH from Ber. Studienges. zur Foerder. der Kernenergieverwertung in Schiffbau und Schiffahrt eV, Hamburg, report 11 (Munich), 1968 Sponsored by AEC Prepared for Oak Ridge Natl. Lab.
(ORNL-tr-2214; Rept-11) Avail: CFSTI

Transmission and reflection matrices of plane layers are calculated for gamma-rays with the MOTRA 1-4 programs on the TR 4 computer. Comparisons were made with the double-P1 transport program GAMP 3 on the ER 56. First the principles of the theory are considered. Then, the computer programs used are described. Finally, a report is given on the numerical results which are based on calculations with a suitably selected standard example. NSA

N70-19698# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
RADIATION DAMAGE FROM PILE NEUTRONS. NEUTRON FLUX AND INDUCED DAMAGE [DOMMAGES D'IRRADIATION EN NEUTRONS DE PILE FLUX NEUTRONIQUE ET DOMMAGES INDUITS]
J. P. Genthon Mar. 1969 15 p refs In FRENCH Presented at the Symp. on Radiation Damage in Solids and Reactor Mater., Vienna, 2-6 Jun. 1969
(CEA-CONF-1304; CONF-690620-4) Avail: CFSTI

The source S is measured as directly as possible through the use of a conveniently chosen physical effect M, by displacements induced in a solid by a neutron flux. An experimental and theoretical analysis is given of how this source is bound to the spectral distribution of this flux. The method is to measure, at ambient temperatures, the variation of electric resistivity of samples; the results reported concern tungsten in fast fluxes, graphite, and titanium. Another method in its early stages is that of canalization of alpha particles. The interpretation shows the validity of the model used concerning the ionization phenomenon and seems to confirm the phenomenon of zone displacements; it is noted that the agreement of fast and thermal neutron effects is overestimated in the calculation which takes into account only the energy transferred to the system. Author (NSA)

N70-19701# New Mexico State Univ., Las Cruces. Dept. of Physics.
SECOND-ORDER CORRELATION TO THE LAMBDA BINDING ENERGY IN NUCLEAR MATTER
B. Ram and W. Williams [1969] 7 p refs
(TID-25249) Avail: CFSTI

The second-order correction to the A binding energy in nuclear matter evaluated in the independent pair approximation is found to be small. Author (NSA)

N70-19702# Notre Dame Univ., Ind. Dept. of Physics.
BROKEN-SYMMETRY MASS FORMULAS FOR THE J SUP P = 1/2(+) BARYON OCTET FROM S-MATRIX THEORY
James T. Cushing and Udo W. Pooch [1969] 39 p refs Supported in part by AEC
(COO-427-95) Avail: CFSTI

The S-matrix derivation of broken-symmetry mass formulas previously given for the J sup P = 0(-) octet of pseudoscalar mesons is extended to the octet of J sup P = 0.5(+) baryons. Also the relation of crossing to the discrete symmetries of C and T (and of Bose statistics) is discussed. Author (NSA)

N70-19703# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ELECTROMAGNETIC DEENERGIZATION OF SEVERAL ENERGY LEVELS OF NI 58 [DESEXCITATION ELECTROMAGNETIQUE DE QUELQUES NIVEAUX PARTICULIERS DE Ni 58]
P. Beuzit, J. Delaunay, J. P. Fouan, and H. Ronsin [1969] 1 p refs In FRENCH Presented at the Intern. Conf. on Properties of Nucl. States, Montreal, 25-30 Aug. 1969
(CEA-CONF-1327; CONF-690804-3) Avail: CFSTI

The (p,p(prime)gamma) reaction at proton energy of 12 MeV was used to study the nature of the first excited levels of (p,p(prime)gamma) by determining their mode of electromagnetic deexcitation. In the framework of the vibrational image the levels of Ni-58 can be classified into the 1-phonon level at 1.453 MeV, the 2-phonon levels at 2.457 2.771, and 2.941 MeV and the 3-phonon levels at 3.775 MeV, 5.064 MeV, and 5.171. The possible existence of a very tight doublet (4 keV) was revealed. A scheme compatible with the experiences with this doublet is presented. NSA

N70-19704# California Univ., Livermore. Lawrence Radiation Lab.
DETERMINATION OF ANTIKAON NUCLEON ELASTIC SCATTERING AMPLITUDES
David Saal Bailey Mar. 1969 98 p refs
(UCRL-50617) Avail: CFSTI

A phase shift analysis was used to determine the antikaon nucleon elastic partial wave amplitudes below 1.4 GeV/c laboratory momentum. The analysis used a separation of the partial wave amplitudes into resonant and nonresonant parts. Several parametrizations of the background amplitudes were tried. The phase shift results for the nonresonant amplitudes indicate a dominance by the J = 1/2 states. The necessity for using known resonant states was demonstrated, the parity assignments of the more elastic resonances were confirmed, and a new resonance in the P(01) state is suggested. As a partial validation of the parametrizations employed and a precursor to a many channel analysis, a three channel S wave model calculation was performed. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N70-18308# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
PRODUCTION OF NONEQUILIBRIUM PLASMAS IN INDIUM ANTIMONIDE
Betsy Ancker-Johnson Sep. 1969 41 p refs Presented at Am. Phys. Soc. Meeting, Honolulu, Hawaii, 4 Sep. 1969
(AD-696294; DI-82-0908) Avail: CFSTI CSCL 20/12

Electrons and holes in excess of their thermal equilibrium density are generally produced in a semiconductor by one (or more) of these three means: (1) electrical injection, (2) optical injection, or (3) impact ionization. If the excess carrier density so produced is large compared with the recombination center density, a 2-component, electron-hole plasma results which is analogous to an electron-ion plasma. The work described here is motivated by the

desire to obtain a fundamental understanding of electron-hole plasmas in their transient state and nonequilibrium steady-state. Author (TAB)

N70-18370# Naval Research Lab., Washington, D.C. Radar Div.
PROJECT SESAMISEED: AN INVESTIGATION OF PLASMA TURBULENCE IN THE LOWER E-LAYER AND ITS RELATIONSHIP TO SPORADIC E
J. R. Davis *In its* Rept. of NRL Progr. Dec. 1969 p 1–11 refs (See N70-18369 07-34)
Avail: CFSTI

Project SESAMISEED involves the use of gun- and rocket-emplaced alkali plasma clouds in the lower E-layer as radar-reflective tracers of the fluid motions in this highly turbulent region of the atmosphere. Decameter-wavelength radar is used for illumination of cesium plasma clouds in the ionosphere over Wallops Island, and data indicate that the explosively injected, dilute plasma cloud displays four phases of evolution: (1) Phase 1 is a period of blast-wave expansion (4 to 10 seconds duration), in which a sequence of shock waves is seen to impinge on the stably expanding contact surface. (2) Phase 2 is a period of ordered diffusion (may last several tens of seconds), in which the ellipsoidal plasma cloud remains a single-scatterer to decameter radiation. (3) Phase 3 is a period of highly irregular motion (normally several minutes), in which collective behavior involving the entire plasma cloud occurs frequently. (4) Phase 4 is an infrequent occurrence (may last tens of minutes), in which the plasma cloud is seen to evolve into a sporadic E-like reflecting layer. Many aspects of Phases 3 and 4 are best explained in terms of a crossed-field plasma instability, in which crossed electric and magnetic fields act upon a properly oriented plasma density gradient to provide energy for the instability. The rationale for postulating this type of plasma instability is discussed, and plans for further analysis are described. Author

N70-18376*# Harvard Coll. Observatory, Cambridge, Mass.
ORBITAL PLASMA TEST FOR HARVARD OSO-D EXPERIMENT
Stanley M. Diamond May 1969 42 p
(Contract NASw-184)
(NASA-CR-107948; TR-8) Avail: CFSTI CSCL 20I

A test was conducted by the Harvard College Observatory (HCO) to investigate the effect of orbital plasma on the operation and performance of the HCO Experiment for the NASA spacecraft OSO-D. Another objective was to determine an optimum ion grid configuration to reduce the plasma entering the outer covers of the experiment. The test was conducted by installing the experiment in a simulated space environment and recording the effects of different plasma environments on the system performance. The tests showed that orbital plasma does not detract from the performance of the HCO Experiment and does not induce any high voltage discharge during its operation. Author

N70-18388# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONLINEAR STABILIZATION OF PLASMA BEAM INSTABILITIES
V. N. Tsytovich et al 4 Apr. 1969 25 p refs Transl. into ENGLISH from Akad. Nauk USSR. Fiz.-Tekhn. Inst. Dokl. (Kiev), no. 76, 1964 p 3-14
(AD-696554; FTD-MT-24-393-68) Avail: CFSTI CSCL 20/9

The possibility of the stabilization of beams in plasmas is discussed, especially for the case where ion temperature greatly exceeds the electron temperature. The chief mechanism responsible for limiting beam or stream instabilities is wave scattering by a large number of ions. The problem is discussed in terms of the spectral shift of the plasma waves from the resonant to nonresonant regions. If the shift occurs in a period less than or of the order of the time of growth of the waves, then stabilization occurs. This occurs in some instances without the presence of strong external noise. General stability criteria are derived from the nonlinear kinetic equations for the beams with large velocity spread. It is shown that the small velocity spread leads to a modified criterion of instability where the electron thermal velocity exceeds that of the ions. Author (TAB)

N70-18396# Army Foreign Science and Technology Center, Washington, D.C.
DETERMINATION OF THE LUMINOSITY OF AIR N2 AND CO2 AT TEMPERATURES OF APPROXIMATELY 10,000 K
N. N. Ogurtsova et al 23 Oct. 1969 13 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperature (Moscow), vol. 6, no. 5, 1968 p 44
(AD-696450; FSTC-HT-23-632-69) Avail: CFSTI CSCL 20/9

In an arc, stabilized by whirl currents of the gas being investigated, plasma is sucked through electrodes and in this way electrode contamination is eliminated. There is an arc source, receiving a homogenous solumn of clear gas plasma. In the spectrum area of 0.2-3 micrometers, the integral luminosity of air, N2 and CO2 is measured. Measurement is accomplished at atmospheric pressure and at a temperature of approximately 10,000K. Discharge in air is evaluated by the inclusion of the luminosity of several spectral areas into the integral luminosity of plasma. Author (TAB)

N70-18427# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
INFLUENCE OF SPATIAL DISPERSION ON THE SPECTRUM OF MAGNETOPLASMA WAVES IN BISMUTH
V. S. Edelman May 1969 15 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 56, no. 1, 1969 p 25-31 Sponsored by MIT, Lincoln Lab.
(Rept-182-69-408-RULL) Avail: CFSTI

At a frequency of approximately 9 GHz, the dependence of magnetoplasma wave velocities and damping in bismuth was investigated as a function of the magnetic field with a strong spatial dispersion, associated with electron drift along the wave vector. By using an ellipsoidal model of the Fermi surface of bismuth computation was made of the spectrum of the waves, taking into account the spatial dispersion, and the results of the computations are compared with experiment. The change was found in the velocity of the magnetoplasma wave as a function of the distance from the sample surface with strong Landau damping. Author

N70-18448*# Michigan Univ., Ann Arbor. Electron Physics Lab.
HARMONIC GENERATION IN NONLINEAR BEAM-PLASMA SYSTEMS
G. T. Konrad Jan. 1969 292 p refs
(Grant NGL-23-005-183; Contract DA-28-043-AMC-01315(E); Grant NSF GK-1708)
(NASA-CR-107956; TR-112) Avail: CFSTI CSCL 20I

The purpose is to investigate both theoretically and experimentally the saturation characteristics of beam plasma devices. The gain, power output, efficiency and the magnitude of the higher harmonic components that pertain to such devices are of particular interest. The geometry treated consists of a cylindrical plasma column which serves as a slow wave circuit along which electromagnetic energy can propagate. A cylindrical electron stream is assumed to be concentric with the plasma column. Amplification of an RF signal takes place when a fraction of the kinetic energy of the stream electrons is converted into RF wave energy. Coupling of RF energy into and out of the beam plasma device is considered in detail. Short sections of a slow wave structure outside of the plasma region are used in the device under test for much of the experimental work. Another coupling scheme making use of quasi-optical techniques is a set of elliptic cavity couplers. Author

N70-18492# Stanford Univ., Calif. Plasma Gasdynamics Lab.
A COMPUTER PROGRAM FOR THE CALCULATION OF THE ELECTRON TRANSPORT COEFFICIENTS

M. Mitchner Aug. 1969 37 p
(Contract F33615-69-C-1171)
(AD-696243; SUIPR-280; AFAPL-TR-69-63) Avail: CFSTI CSCL 20/9

A general computer program is described for the calculation of the electron transport coefficients in a partially ionized collision-dominated gas with or without a magnetic field. Included are the electrical conductivity, thermal conductivity, thermal diffusion coefficient, and the Hall parameter. Complete instructions are provided for the use of the program. Author (TAB)

N70-18512# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VOLT-AMPERE CHARACTERISTICS OF AN a-c ARC BURNING IN A VORTEX-CIRCUIT PLASMATRON
V. A. Bogatyreva et al 7 May 1969 9 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Sibirskoye Otd., Izv., Ser. Tekh. Nauk (Russian), no. 13, 1967 p 159-162
(AD-696474; FTD-HT-23-1343-68) Avail: CFSTI CSCL 20/9

Investigation of the plasmatron with gas-vortex stabilization of the arc made it possible to establish the volt-ampere characteristic of the arc in criterial form in the considered range of changes of determining complexes. The proposed formula can be used in designing high-power plasmatrons. A heavy-current a-c industrial frequency arc in the company of an auxiliary h-f arc burns in a plasmatron stably and without breaks in the current. Author (TAB)

N70-18700# Michigan Univ., Ann Arbor. Dept. of Aerospace Engineering.
ON THE PROPAGATION OF IONIZATION WAVES
R. Munt, R. S. B. Ong, and D. L. Turcotte 19 Mar. 1969 13 p refs Prepared in cooperation with Cornell Univ.
(Contract AF-AFOSR-825-67)
(AD-696274; AFOSR-69-2740TR) Avail: CFSTI CSCL 20/9

A non-linear analysis of ionization wave fronts is given including energy effects. The necessary external energy source is Joule heating due to an applied transverse electric field. The front propagates at a speed which is proportional to the product of the electron sound speed and the square root of the ratio of the electron collision time to the reaction time. The structure of the ionization wave is also obtained. Author (TAB)

N70-18726*# National Aeronautics and Space Administration, Washington, D.C. Scientific and Technical Information Div.
PLASMAS AND MAGNETIC FIELDS IN PROPULSION AND POWER RESEARCH
1970 253 p refs Held at Langley, Va., 16 Oct. 1969
(NASA-SP-226) Avail: CFSTI CSCL 20I

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N70-18727*# National Aeronautics and Space Administration, Washington, D.C.
PLASMA PHYSICS OF ELECTRIC ROCKETS
George R. Seikel, Denis J. Connolly, Charles J. Michels, Edward A. Richley, and J. Marlin Smith et al *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 1-64 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20I

The major plasma processes of two basically different type thrusters (electron bombardment ion thrustor and magnetoplasmadynamic arc thrustor) are investigated over a wide range of power levels. The concept, configuration, performance, ion extraction system, ion source power balance, and volume ion production cost are described for the electron bombardment ion thrustor. A discussion is presented of: the magnetodynamic arc concept, instabilities and turbulence, acceleration mechanisms, arc thrustors, high power losses, and test facility. It is concluded that the major inefficiencies for both systems are the result of the same plasma processes. These are: (1) the fundamental power losses associated with carrying current to an anode, and (2) the loss of power associated with ionizing a plasma. F.O.S.

N70-18728*# National Aeronautics and Space Administration, Washington, D.C.
CLOSED-CYCLE MAGNETOGASDYNAMIC POWER GENERATION
Lester D. Nichols *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 65-84 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20I

The principles of operation in magnetohydrodynamic (MHD) generators are investigated. One of the advantages of an MHD system is that it is considered simpler than turboalternators because of the lack of seals, bearings, and auxiliary equipment associated with rotating machinery. Discussed are the types of generators, both open and closed thermodynamic cycle; generator current-voltage characteristics; electron heating, effect of fluctuations, effect of impurities, and space power systems study. F.O.S.

N70-18729*# National Aeronautics and Space Administration, Washington, D.C.
PLASMA HEATING AND CONTAINMENT
Warren D. Rayle, John J. Reinmann, J. Reece Roth, and Donald R. Sigman *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 85-122 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20I

The possibility of controlled thermonuclear fusion for space power and propulsion was studied. The required parameters for deuterium-tritium, or deuterium- helium-3 are shown as: temperature, 10 to the 8th power to 10 to the 10th power K; confinement time, 0.1 to 1.0 sec; density, particle/cubic meter, 10 to the 20th power to 10 to the 22nd power; magnetic field, T, 5 to 10. The major fusion research problems are considered to be plasma confinement, and plasma production and heating. The problems of plasma instability and ion heating are discussed. F.O.S.

N70-18730*# National Aeronautics and Space Administration, Washington, D.C.
THERMIONIC PLASMAS
Harold E. Neustadter *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 123-142 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20I

The thermionic conversion processes are studied in the ignited and unignited modes for space application. The role of the plasma in the process is analyzed and plots of current against voltage output are presented. F.O.S.

N70-18733*# National Aeronautics and Space Administration, Washington, D.C.
SIMULATION OF SOLAR-WIND-EARTH-MAGNETOSPHERE INTERACTION
Donald L. Chubb *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 203-222 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20I

Research on solar-wind - Earth-magnetosphere interaction at the Lewis Research Center as a natural outgrowth of research on magnetoplasmadynamic arc thrusters is described. The flow obtained in the initial exploratory experiments is shown. The highly ionized high-velocity hydrogen exhaust of the water-cooled arc is used to represent the solar-wind flow. A dipole electromagnet in the insulated globe simulates the Earth's magnetic field. Although these preliminary experiments were encouraging, significant improvements are required to obtain an adequate simulation of solar-wind - Earth-magnetosphere interaction. This paper describes the progress being made toward that goal. Author

N70-18734*# National Aeronautics and Space Administration, Washington, D.C.
PLASMA CHEMISTRY AND ION-MOLECULE
John V. Dugan, Jr. *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 223-240 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20I

This discussion is concerned with the computation of cross sections for electron and heavy-particle collisions as well as with their plasma applications. These plasma collisions determine plasma chemistry. Electron-atom collisions and impacts of ions on molecules are of interest for plasma rate calculations. An outline of approaches and results is shown. The microscopic cross sections for such processes are required to calculate their relative probabilities. For a fixed temperature, the rate constant (or collision coefficient) is a very useful kinetic quantity. The Maxwell averaged product of cross section and velocity is denoted. These coefficients are used in both plasma continuity and energy equations to determine species number densities and temperatures. Author

N70-18798*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
SOURCES OF ELECTRON ENERGY IN WEAKLY IONIZED EXPANSIONS OF NITROGEN
John A. Lordi and Michael G. Dunn Aug. 1969 27 p refs
(Contract NAS5-9978)
(NASA-CR-108127; CAL-AI-2187-A-16) Avail: CFSTI CSCL 20I

Experimental data for the variation of electron temperature and number density along a nozzle expansion of weakly ionized nitrogen have been used to evaluate the terms in the electron energy equation. These measurements, which were used previously to infer the dissociative-recombination rate coefficient for N2(+), were made in a shock tunnel using thin-wire Langmuir probes and microwave interferometers. As found by previous investigators, the electron temperature remains significantly higher than the heavy-particle translational temperature. Electron thermal energy transfer with the translational, rotational and vibrational degree of freedom of N2 is shown to control the electron temperature. Ohmic heating, thermal conduction, recombination heating and absorption of radiation are all negligible and the primary source of electron energy is the exchange with vibration. The measured electron temperatures are also compared with calculations of the N2 vibrational temperatures. Author

N70-18853*# California Univ., Berkeley. Dept. of Physics.
DISCRETE SPECTRA AND DAMPED WAVES IN QUASILINEAR THEORY
George Vahala (Iowa Univ.) and David Montgomery (Iowa Univ.) Dec. 1969 25 p refs
(Grants NGR-05-003-220; NGR-16-001-043)
(NASA-CR-108126) Avail: CFSTI CSCL 20I

The consequences of the quasilinear equations are explored. Particular attention is paid to the differences between the one dimensional and the two and three dimensional cases, and to the differences between the cases of discrete and continuous wave number spectra. The possibilities of and problems associated with including damped waves are treated. The relation between conservation laws and the resonance approximation, in which the limit of zero growth rate for the unstable waves is taken at finite times, is clarified. Numerical solutions for the one dimensional case with finite growth rate are presented. Author

N70-18861*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
MODEL STUDY OF PLASMAPAUSE MOTION
J. M. Grebowsky Dec. 1969 19 p refs
(NASA-TM-X-63813; X-621-69-543) Avail: CFSTI CSCL 20I

A simple time dependent model which accounts for the observed behavior of the bulge is developed for the plasmapause motion during periods of changing magnetic activity. The development is described of a steady state model, which is based on the assumption that the geomagnetic field arises from a magnetic dipole centered in the earth with no tilt between the dipole and the axis of rotation, and the effects of currents external to the earth are ignored. In the equatorial plane of this model the gross electric field which drives the plasma flow is derived from two sources: (1) The rotation of the conducting earth through the dipole magnetic field produces a polarization charge within the earth,which produces an electric field directed radially outwards. (2) The interaction between the solar wind and the magnetosphere is the other component, and corresponds to a plasma flow toward the sun from the magnetosphere tail. Based on this model, a time depedent model is developed. F.O.S.

N70-18872# Academy of Sciences (USSR), Moscow.
ANOMALOUS ABSORPTION OF AN ELECTROMAGNETIC WAVE IN A COLLISIONLESS PLASMA. PLASMA HEATING IN A STRONG UHF FIELD
1969 31 p refs In RUSSIAN and ENGLISH Presented at the 9th Intern. Conf. on Phenomena in Ionized Gases, Bucharest, 31 Aug.-6 Sep. 1969
(NP-17962) Avail: AEC Depository Libraries CSCL 20/9

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1. INVESTIGATIONS OF THE ANOMALOUS ABSORPTION OF A HIGH-POWER H 11 WAVE IN A CIRCULAR WAVEGUIDE BY A DENSE COLLISIONLESS PLASMA I. R. Gekker and O. V. Sizukhin p 1-11 refs (See N70-18873 07-25)

2. DECAY OF A COLLISIONLESS PLASMA FLOW NEAR A CRITICAL DENSITY IN UHF FIELD K. F. Sergeichev p 12-21 refs (See N70-18874 07-25)

3. AN ANOMALOUS HEATING OF PLASMA ELECTRONS IN A STRONG SHF FIELD G. M. Batanov, K. A. Sarksian, and V. A. Silin p 22-31 refs (See N70-18875 07-25)

N70-18873# Academy of Sciences (USSR), Moscow.
INVESTIGATIONS OF THE ANOMALOUS ABSORPTION OF A HIGH-POWER H 11 WAVE IN A CIRCULAR WAVEGUIDE BY A DENSE COLLISIONLESS PLASMA
I. R. Gekker and O. V. Sizukhin *In its* Anomalous Absorption of an Electromagnetic Wave in a Collisionless Plasma. Plasma Heating in a Strong UHF Field 1969 p 1-11 refs In RUSSIAN and ENGLISH (See N70-18872 07-25)
Avail: AEC Depository Libraries

Two regimes of electromagnetic wave intensity were investigated on the RAMUS 2 installation. The first regime of a

linearly polarized travelling wave was injected by a spark source from the end of a circular waveguide through a microwave dummy load, while in the second regime the microwave dummy load was absent and a plasma was injected in the standing wave directly through a metal grid which occupied the full cross section of the waveguide. Oscillograms of reflected microwave power from a short circuit, plasma piston, and electric probe are given. It is shown that the relative level of reflected microwave power which is unstable from one plasma to another decreases with the increase of the electric field strength. Both regimes also exhibited regions of short lived minimum reflection. J.M.C.

N70-18874# Academy of Sciences (USSR), Moscow.
DECAY OF A COLLISIONLESS PLASMA FLOW NEAR A CRITICAL DENSITY IN UHF FIELD
K. F. Sergeichev *In its* Anomalous Absorption of an Electromagnetic Wave in a Collisionless Plasma. Plasma Heating in a Strong UHF Field 1969 p 12-21 refs In RUSSIAN and ENGLISH (See N70-18872 07-05)
Avail: AEC Depository Libraries

The decay of the collisionless plasma flow was observed while passing a plasma along the axis of a circular waveguide. The plasma flowing into the waveguide was exposed to the action of a strong disturbance in the presence of the microwave power. Ions acquired large transversal energies which led to the appearance of ion currents in the circuits of the ring collectors placed near the walls of the waveguide. By using the ring collectors, it was possible to measure the distribution of ions scattered to the walls with relative distance at different levels. A value of electric field strength was calculated for the vacuum waveguide at a boundary of the plasma flow. Experimental and theoretical results are in good agreement. Author

N70-18875# Academy of Sciences (USSR), Moscow.
AN ANOMALOUS HEATING OF PLASMA ELECTRONS IN A STRONG SHF FIELD
G. M. Batanov, K. A. Sarkisan, and V. A. Silin *In its* Anomalous Absorption of an Electromagnetic Wave in a Collisionless Plasma. Plasma Heating in a Strong UHF Field 1969 p 22-31 refs In RUSSIAN and ENGLISH (See N70-18872 07-25)
Avail: AEC Depository Libraries

The electron temperature variations are investigated in a rarefied collisionless magnetoactive plasma due to the electron scattering by plasma oscillations. Experiments are performed in a circular waveguide with a travelling node. A homogeneous magnetic field is applied across the waveguide and a cylindrical plasma is created by a spark gun and moved along the field. Results show that the electron energy spectrum is defined by the SHF field strength, and that the generation phenomena of fast electrons in SHF field cannot be explained by Coulomb's collision. J.M.C.

N70-18914*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
PLASMA PHYSICS ABSTRACTS, 1 JANUARY-31 DECEMBER 1969
David C. Montgomery and Donald A. Gurnett Dec. 1969 10 p refs
(Grant NGR-16-001-043)
(NASA-CR-108121) Avail: CFSTI CSCL 20I

Theoretical and ionospheric plasma studies reported pertain to numerical solutions for plasma problems, heating and oscillation effects of electron beam interactions with plasmas, and instrumentation for plasma measurements. Ionospheric work constitutes satellite observations of electric and magnetic fields, the development and effects of electrostatic noise, and the presence of charged ions in the ionosphere. G.G.

N70-18946# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ANNUAL REVIEW, APRIL 1968-MARCH 1969
Mar. 1969 119 p refs
Avail: CFSTI

The various projects involving creation and measurement of plasmas are reviewed. Fundamental experiments in plasma control are outlined. The theory of plasma configuration is discussed and the research facilities are described. R.B.

N70-19066 Lehigh Univ., Bethlehem, Pa.
TRANSPORT PROPERTIES OF A PLASMA IN A STRONG MAGNETIC FIELD
Barry Jay Gilbert (Ph.D. Thesis) 1968 107 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 69-7334

The kinetic description for a plasma in a strong external magnetic field was recently developed in a form suitable for transport property calculations. A magnetic field is considered strong when it not only affects the trajectories of particles between collisions, but also when the collision process itself is altered by the presence of the field. It is assumed that the ions are randomly distributed in space and act as fixed scattering centers for the electrons. It is further assumed that the electron distribution function is axially symmetric about the magnetic field direction (gyro-tropic). A weak electric field and small temperature gradient are imposed parallel to the magnetic field. Since any flows that are set up by these imposed quantities must be along the field lines, the symmetry of the distribution function will be maintained and gyrotropy will not be disturbed. We calculate these longitudinal transport coefficients by expanding the lowest order one-particle distribution in a perturbation expansion. Dissert. Abstr.

N70-19075# Princeton Univ., N.J. Plasma Physics Lab.
DEVELOPMENT OF COLLISIONAL DRIFT-WAVE TURBULENCE
H. W. Hendel and T. K. Chu Oct. 1969 6 p refs Presented at the Intern. Conf. on Phys. of Quiescent Plasmas, Paris, 8-13 Sep. 1969
(Contract AT(30-1)-1238)
(MATT-730; CONF-690923-2) Avail: CFSTI

The development of collisional drift-wave turbulence in the far unstable regime is studied in a lithium Q-machine plasma. For this low ion mass the magnetic field covers a range in the relevant density and temperature ranges. At the highest magnetic field B = 6500 Gauss, the ratio of plasma radius to ion Larmor radius is approximately 60. The results are discussed. NSA

N70-19082# Princeton Univ., N.J. Plasma Physics Lab.
SOFT- AND HARD-ONSET AND AMPLITUDE SATURATION OF COLLISIONAL DRIFT INSTABILITIES
J. K. Chu, H. W. Hendel, L. G. Schlitt, T. C. Simonen, and T. H. Stix Oct. 1969 8 p refs Presented at the Intern. Conf. on Phys. of Quiescent Plasmas, Paris, 8-13 Sep. 1969
(Contract AT(30-1)-1238; Grant NSF GP-579)
(MATT-731; CONF-690923-1) Avail: CFSTI

Measurements are reported of the onset of low azimuthal modes and of the amplitude behavior for the collisional drift instability in Q machine alkali metal plasmas, together with an interpretation based on mode coupled Landau type master equations. NSA

N70-19093# Rochester Univ., N.Y.
AN EXPERIMENTAL INVESTIGATION OF LASER PLASMA INJECTION IN A TOROIDAL MULTIPOLE. A: MICROWAVE HEATING RESULTS Annual Progress Report, 15 Nov. 1968-14 Nov. 1969
Moshe J. Lubin 14 Nov. 1969 32 p refs
(Contract AT(30-1)-4054)
(UR-4054-6) Avail: CFSTI

ECRH-produced plasmas in the high-field quadrupole exhibit behavior within the stable region beyond a critical value of magnetic field. Data reduction is presently underway on a correlation of

fluctuation level with anomalous radial loss. An estimate of the initial conditions for the plasma decay studies is in good agreement with measured densities and electron temperatures. The behavior of the confinement time indicates that in the back-biased condition (yielding a peak magnetic field of 19 kG), this quadrupole is a workable geometry for laser plasma studies. Author (NSA)

N70-19139*# Techtran Corp., Glen Burnie, Md.
OHM'S LAW FOR A PARTIALLY IONIZED PLASMA IN CROSSED ELECTRIC AND MAGNETIC FIELDS AT HIGH DIFFUSION RATES [ZAKON OMA DLYA CHASTICHNO IONIZIROVANNOY PLAZMY V SKRESHCHENNYKH ELEKTRICHESKOM I MAGNITNOM POLYAKH PRI BOL'SHIKH SKOROSTYAKH DIFFUZII]
Ye. P. Vaulin et al Washington NASA Feb. 1970 10 p refs Transl. into ENGLISH from Magnitn. Gidrodinam. (USSR), v. 4, 1968 p 9–14
(Contract NASw-1695)
(NASA-TT-F-12845) Avail: CFSTI CSCL 20I

The formulation (in hydrodynamic approximation) of a generalized Ohm's law is presented for partially ionized plasma in crossed fields, with allowance for ion slipping relative to the neutrals. The nonlinear dependence of the friction forces among the plasma components on the diffusion rate is examined. It is shown that when the diffusion and thermal rates are compatible, plasma conductivity is substantially influenced by the absolute current density. Author

N70-19141*# Techtran Corp., Glen Burnie, Md.
THE MAGNETIC PROPERTIES OF THE RELATIVISTIC PLASMAS [MAGNITNYYE SVOYSTVA RELYATIVISTSKOY PLAZMY]
V. A. Ruban Washington NASA Feb. 1970 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 3, 1967 p 67–74
(Contract NASw-1695)
(NASA-TT-F-12798) Avail: CFSTI CSCL 20I

The magnetic properties of relativistic plasma equilibrium in Boltzmann and quantum random fields are studied, based on thermodynamic functions calculated in form. It is shown that for a relativistic degenerate gas of free electrons the de Haas-Van Alphen effect is preserved. Author

N70-19235*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
SPECTRUM OF AN ALUMINUM PLASMA EXCITED BY LASER RADIATION [SPEKTR ALYUMINIYEVOY PLAZMY, VOZBUZHDAYEMOY LAZERNYM IZLUCHENIYEM]
B. M. Zhiryakov et al Washington NASA Feb. 1970 4 p refs Transl. into ENGLISH from Zh. Prikl. Spektroskopii (Russian), v. 10, no. 1, Jan. 1969 p 143–145
(Contract NASw-1692)
(NASA-TT-F-12694) Avail: CFSTI CSCL 20I

A discussion is presented of the spectral features of an aluminum plasma which was obtained by a giant-pulse ruby laser focused on an aluminum target. The spectrum of the aluminum plasma is illustrated. Methods for determination of the plasma temperature and density are discussed. Author

N70-19273*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORDINARY-MODE ELECTROMAGNETIC INSTABILITY IN COUNTERSTREAMING PLASMAS WITH ANISOTROPIC TEMPERATURES
M. Bornatici and Kai Fong Lee (Catholic Univ. of Am.) Jan. 1970 27 p refs
(Grant NSF GK-4592)
(NASA-TM-X-63824; X-640-70-21) Avail: CFSTI CSCL 20I

The instability of the electromagnetic linearly polarized mode propagating perpendicular to a uniform magnetic field is studied by using the Vlasov equation for a counterstreaming electron plasma with anisotropic temperatures. An instability occurs if the streaming velocity exceeds a certain threshold value which can be below that required to excite the electrostatic two stream instability. It is found that temperature perpendicular to the field has a stabilizing effect, while parallel temperature enhances the electromagnetic instability. Typical growth rates are of the order of the electron cyclotron frequency. Author

N70-19310*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A POLYNOMIAL METHOD FOR DETERMINING LOCAL EMISSION INTENSITY BY ABEL INVERSION
Chuk Park and Dan Moore Washington Feb. 1970 19 p refs
(NASA-TN-D-5677; A-3444) Avail: CFSTI CSCL 20I

The Abel inversion is applied to the transformation of the measured line of sight integrated radiation intensity from an axially symmetric plasma light source into local emission intensity. Consideration of the physical features of the plasma light source shows that the most appropriate approximation of the radial variation of emission is an even power polynomial. Thus, the measured integrated intensity is represented by a linear combination of Abel transforms of even powers. The formula is precise near the axis of symmetry even when the integrated intensity is known at only two or three lateral positions. The formula becomes inaccurate at large radial distances and is suitable mainly when the emission intensity decreases monotonically toward the boundary. Author

N70-19322*# Humphreys Corp., Concord, N.H. TAFA Div.
INDUCTION PLASMA HEATING: MEASUREMENT OF GAS CONCENTRATIONS, TEMPERATURES, AND STAGNATION HEADS IN A BINARY PLASMA SYSTEM
Peter H. Dundas Washington NASA Feb. 1970 64 p refs
(Contract NAS3-11487)
(NASA-CR-1527) Avail: CFSTI CSCL 20I

The degree of mixing between an argon plasma and a cool sheath of hydrogen has been found to be markedly different from the mixing measured for an identical gas flow system without the plasma. Temperatures measured show that the plasma virtually separates the argon from the sheath gas. The induction skin effect presents itself as temperature maxima which are not on the plasma axis. Author

N70-19328*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
MEASUREMENT OF POTENTIAL IN AN ELECTRON-DOMINATED PLASMA [MESURE DU POTENTIEL D'UNE ONDE PLASMA ELECTRONIQUE]
A. Quemeneur Washington NASA Feb. 1970 88 p refs Transl. into ENGLISH of CEA. Dept. de la Phys. du Plasma et de la Fusion Controlee report EUR-CEA-FC-529
(Contract NASw-1692)
(NASA-TT-F-12847; EUR-CEA-FC-529) Avail: CFSTI CSCL 20I

A capacitive probe of a simple construction which permits the attaining of the oscillating potential associated with a wave is presented. This probe was used to experimentally study the potential of an electron plasma wave in the presence of a strong magnetic field in a radially inhomogeneous plasma column. From measurements of the amplitude of the potential, the perturbed density was derived. The radial potential distributions was also observed determined from which it was observed that the modes are all the more localized in the vicinity of the axis as the frequency is higher. The radial density profile was determined with the aid of the Langmuir probes. Author

N70-19347*# Techtran Corp., Glen Burnie, Md.
ASPECTS OF THE OPERATION OF THE PLEIADE MIRROR: WALL INFLUENCE, CREATION AND SUPPRESSION OF

IONIC CYCLOTRON INSTABILITIES [CONSIDERATIONS SUR LE FONCTIONNEMENT DE PLEIADE MIROIR: INFLUENCE DES PARIOS, CREATION ET SUPPRESSION D'INSTABILITIES CYCLOTRON IONIQUE]

R. Geller et al. Washington NASA Jan. 1970 26 p refs Transl. into ENGLISH from French rept. EUR-CEA-FC-511, Apr. 1969 22 p
(Contract NASw-1695)
(NASA-TT-F-12713; EUR-CEA-FC-511) Avail: CFSTI CSCL 20I

Qualitative data on the operation of the Pleiade Mirror are furnished. Special consideration is given to the effects of the walls on operation. The importance of the terminal walls and the nature of the lateral walls are discussed in detail. The role of the cold plasma is shown. Finally, there is experimental proof that the force potentials (e.g., mass) near the accelerating structure of the mirror can disturb functioning. It is shown that such potentials create instabilities of the ionic cyclotron type by destroying the ionic accumulation while free potentials on the walls assure satisfactory operation. Author

N70-19354*# Techtran Corp., Glen Burnie, Md.
STUDY OF THE OPERATING CONDITIONS OF THE MACHINE HARMONICA ZERO [ETUDE DES CONDITIONS DE TRAVAIL DANS LA MACHINE HARMONICA ZERO]

E. P. Butt et al. Washington NASA Jan. 1970 62 p refs Transl. into ENGLISH from French report EUR-CEA-EC-482, 1968 49 p
(Contract NASw-1695)
(NASA-TT-F-12715; EUR-CEA-EC-482) Avail: CFSTI CSCL 20I

A general investigation of the plasma produced in the circular torus Harmonica Zero has been carried out, with special reference to the influence of the parameters: energy per proton, rotational transform and filling pressure. There is evidence from the results of this study that a two-beam type of instability is present. A large energy loss from the plasma occurs which does not seem to be directly related to the value of the rotational transform. Spectrographic observations emphasize the importance of the injection of the neutrals. Author

N70-19366# Institute of Nuclear Research, Warsaw (Poland).
CONVECTIVE AND ABSOLUTE TWO STREAM INSTABILITIES FOR HOT PLASMAS

E. Infeld and A. Skorupski 1969 8 p refs Presented at the Third Conf. on Controlled Fusion and Plasma Phys., Utrecht
(INR-P-1056; CONF-690619-14) Avail: CFSTI

The problem of stability for two streams of hot, charged particles in the resonance model are resolved. The instabilities are then classified into absolute and convective. Author (NSA)

N70-19381# Atomic Energy Commission, Washington, D.C. Div. of Technical Information.
INVESTIGATION OF AN ELECTROMAGNETIC TRAP

O. A. Lavrentyev [1969] 25 p refs Transl. into ENGLISH from Magn. Lovushki, Vypusk 3, Nauk. Dumka (Kiev), 1968 p 77-147 Revised
(AEC-tr-7002-Rev) Avail: CFSTI

An extensive survey was made of work dealing with electrostatic plasma confinement. An analysis is given for each of the following four topics: (1) electrostatic plasma confinement, (2) magnetic protection of the grid, (3) electromagnetic traps, and (4) experimental investigation of an electromagnetic trap. NSA

N70-19382# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
PLASMA EFFECTS IN ANNULENE MOLECULES

David B. Cheng (Washington Univ.) and James E. Drummond Oct. 1969 39 p refs
(DI-82-0915) Avail: CFSTI

Some plasma effects of the pi-electrons in annulene molecules are studied. The dispersion relation for plasma oscillations, obtained by using Hvackel molecular orbitals in the second quantization formalism, is found to describe sound-like waves. The resulting polarization response of the pi-electrons causes a spatial modulation of the interaction potential between two pi-electrons. The polarization response defines the natural correlation units in annulenes to be quartets in all but the angular momentum + or - 2n states of 4n-annulenes and zero angular momentum states, where the correlation unit is a pair of electrons. Correlation is discussed by using the modified interaction potential with a Wannier hamiltonian in pair and quartet equations. The effect of bond alternation is considered in connection with the variation of induced currents in unsaturated annulenes with temperature. Author

N70-19423# Institute of Nuclear Research, Warsaw (Poland).
THEORY OF THE POPULATION OF EXCITED LEVELS AND IONIZATION EQUILIBRIUM FOR NONTHERMAL PLASMA

Szymon Suckewer 1969 160 p refs
(INR-1027) Avail: AEC Depository Libraries

The influence of differences in the cross sections and on the differences in the calculated population densities for excited levels and in the degree of nonthermal plasma ionization was investigated. Calculations were performed for Maxwellian velocity distribution electrons, characterized by the electron temperature T sub e. Electron temperature and density measurements from relative line intensities are described. NSA

N70-19578# Atomic Energy Commission, Washington, D.C. Div. of Technical Information.
ABSOLUTE MEASUREMENT OF PLASMA PARAMETERS

S. N. Popov [1969] 30 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Inst. Fiz. (Moscow), 1968
(AEC-tr-7101) Avail: CFSTI

The possibilities of obtaining absolute measurements of a number of basic plasma parameters by means of a drift mass spectrometer, in which a receiver with a voltage barrier is used as a current receiver are discussed. Author (NSA)

N70-19632# Joint Publications Research Service, Washington, D.C.
ANOMALOUS ABSORPTION OF CYCLOTRON WAVES IN CONFINED PLASMA

L. S. Bogdankevich et al. AEC [1969] 20 p refs Transl. into ENGLISH from the Russian Report Prepared for AEC
(AEC-TR-7073) Avail: CFSTI

The absorption of the cyclotron electron waves in a confined and rarefied plasma was investigated when the Larmor frequency of electrons exceeded considerably that of the plasma. Under such conditions the extraordinary cyclotron wave is absorbed rather strongly in a spatially unlimited plasma, while the ordinary wave is practically not absorbed at all. In a limited plasma (for example, a waveguide filled with plasma), due to the interaction of waves at the plasma boundary, absorption of the ordinary waves may become anomalously high if the wave length is of the order of the plasma dimension. At this, the absorption factor becomes an oscillating function of the wave length and system dimensions. Cases of high-temperature plasma without collisions and of cold plasma with a great number of collisions were examined. Recent experiments on absorption of the cyclotron waves in a limited plasma are discussed on the basis of the newly developed theory. Author (NSA)

N70-19666# Princeton Univ., N.J. Plasma Physics Lab.
NEW RESULTS IN THE STUDY OF ANOMALOUS PLASMA RESISTANCE IN THE TM-3 TOKAMAK

G. A. Bobrovskii et al. Nov. 1969 16 p refs Transl. into ENGLISH from Russian report No. IAE-1905 In ENGLISH and RUSSIAN

(Contract AT(30-1)-1238)
(MATT-Trans-92; IAE-1905) Avail: CFSTI

An investigation was made of discharge conditions in the TM-3 device with a relatively high temperature and low concentration. Under these conditions protons are detected the temperature of which cannot be explained by Coulomb transfers from electrons to ions in a number of cases. The dependence of the anomalous resistance on certain parameters is studied. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N70-18313# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF DEBYE TEMPERATURE FOR CRYSTALS OF ARBITRARY SYMMETRY

T. G. Bystrova et al 5 May 1969 10 p refs Transl. into ENGLISH from An BSSR. Vestsi. Ser. Fiz.-Matematychnykh Navuk (Russian), no. 1, 1967 p 104-110
(AD-696510; FTD-HT-23-873-68) Avail: CFSTI CSCL 20/12

This is a continuation of earlier work by one of the authors where a method was developed for the calculation of the Debye temperatures for crystals of various symmetry. In the present article the method is applied to crystals of lower symmetry - triclinic and monoclinic. Although the derived formulas are suitable for the most general case of triclinic crystals it is pointed out that their practical use is limited by the lack of data on the elastic constants of triclinic crystals. Tables of the elastic constants and of the Debye temperatures are presented for various compounds. TAB

N70-18321*# Illinois Univ., Urbana. Coordinated Science Lab.

TUNNELING IN SEMICONDUCTORS

C. B. Duke Aug. 1969 29 p refs Sponsored in part by JPL
(Contracts JPL-952383; DAAB07-67-C-0199)
(NASA-CR-107935; AD-693805; R-425) Avail: CFSTI CSCL 20L

Historical highlights of studies of current flow across metal-semiconductor contacts via electron tunneling are outlined. The physical origin of the space-charge potential at a rectifying metal contact on a degenerate semiconductor is illustrated with emphasis on the features of this potential which determine the dominant mechanism of current flow across the contact. Recent experiments on the tunneling characteristics of these junctions are described. Their interpretation in terms of phenomenological independent-electron models is discussed critically. The tunneling spectroscopy of collective excitations is described by use of the transfer-Hamiltonian model. The influence of features of the phonon spectra in the semiconductor on inelastic tunneling is illustrated for Ge. The effects of electronic interactions with collective excitations in the semiconductor electrode are discussed for phonons in Si and CdS, and for plasmons in GaAs. Author

N70-18329# North Carolina State Univ., Raleigh.

ON MICROCONTINUUM THEORIES OF POLYCRYSTALS AT SMALL STRAIN

Kerry S. Havner Oct. 1969 38 p refs
(Contract N00014-68-A-0187; ARPA Order-1090)
(AD-696557; TR-69-7) Avail: CFSTI CSCL 20/11

Microcontinuum theories for inelastic analysis of rate-independent polycrystals at small strain are investigated. For a macroscopically homogeneous solid, the infinite aggregate model of T. H. Lin is extended to include more general crystal hardening theories and an ordered elastic anisotropy. Corresponding integrodifferential equations for incremental response under uniform averaged stress are derived. The macroscopic (apparent) plastic strain rate is newly defined in terms of a microcontinuum velocity field due to continuous crystalline slip and aggregate self-stressing, and several general theoretical results of R. Hill are shown to apply to the extended infinite model. The question of an appropriate definition of latent strain energy in the unloaded aggregate also is considered. Author (TAB)

N70-18379# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THERMOPHYSICAL PROPERTIES OF ALLOYS IN THE SYSTEMS BORON-NITROGEN, BORON-CARBON, SILICON-NITROGEN, AND BORON-SILICON-CARBON

G. V. Samsonov 14 Feb. 1969 18 p refs Transl. into ENGLISH from Poroshkovaya Met., (USSR), v. 1, no. 3, 1961 p 53-62
(AD-696303; FTD-HT-23-1070-68) Avail: CFSTI CSCL 20/12

The paper deals with an investigation of the properties of a number of high temperature semiconducting alloys manufactured by powder metal methods. It is shown that the compound BN in the boron-nitrogen system possesses an extensive region of homogeneity; the rearrangement of the boron lattice during nitrogenization leads to the formation of alloys in the nitride homogeneity region with predominance of electronic conductivity. With an increase in the nitrogen content in the nitride the electrical resistance of the latter sharply rises up to 35-38 percent of nitrogen, after which the rise in resistance is decelerated, which is accounted for by the participation in the conductivity of electrons effecting the bonds between the plane layers of atoms in the nitride structure. It is established that Si3N4 is a semiconductor. The nature of the effect of additions of carbon and titanium on silicon nitride conductivity is shown. The author shows the existence of two carbides - B4C and B12C - in the boron-carbon system. Author (TAB)

N70-18493# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPERCONDUCTIVITY OF CONTACTS BETWEEN FILMS OF DIFFERENT METALS

I. A. Artemenko 8 Sep. 1969 7 p refs Transl. into ENGLISH from Dokl. Fiz-Tekhnol. Vopr. Kibernetiki, (Russian) 1967 p 61-65
(AD-696312; FTD-HT-23-395-69) Avail: CFSTI CSCL 9/2

Tin-lead and indium-lead transition contacts in film cryotrons were investigated. Vacuum was interrupted between application of the two films. Resistance-temperature curves are presented. Threshold current for the contacts at 0.2K was 15-20 percent below that for the pure films. Operation of actual memory cells verified superconduction in these contacts. TAB

N70-18513# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABSORPTION SPECTRA IN THE VACUUM ULTRAVIOLET REGION OF LiF CRYSTALS IRRADIATED BY REACTOR AND GAMMA-RADIATION

A. V. Podin 10 Apr. 1969 7 p refs Transl. into ENGLISH from Akad. Nauk Latv. SSR. Izv. Fiz. i Tekhn. Nauk (Latvian), no. 5, 1966 p 124-126
(AD-696166; FTD-HT-23-1282-68) Avail: CFSTI CSCL 20/12

A study was made of the rate of formation of optical absorption spectra in the vacuum uv range (from 11 to 5 ev.) under the effect of reactor and gamma radiation. The structure of the absorption spectra in the vacuum uv range under gamma radiation does not differ from that under reactor radiation. The color centers in the vacuum uv range are more effectively formed by gamma radiation at comparable absorbed doses. The ratio of increase of the absorption coefficient in the 6- to 9-ev. range to the absorption coefficient of the F band in the LiF crystals (in vacuo) is greater than in the LiF crystals (in air). Therefore, the effect of admixture on the rate of color center formation varies considerably for the different centers. Author (TAB)

N70-18526# Army Electronics Command, Fort Monmouth, N.J.
COMPUTER-AIDED TECHNIQUE FOR THE ACCURATE DETERMINATION OF THE SEMICONDUCTOR IMPURITY DOPING PROFILE Research and Development Technical Report
Joseph J. Baranowski and Vincent J. Higgins Oct. 1969 22 p
(AD-697127; ECOM-3186) Avail: CFSTI CSCL 20/12

The basic equations for the determination of semiconductor net impurity doping profiles are derived. A computer technique is introduced which aids the accurate solution of the basic equations. The described method is mathematically rigorous and represents a vast improvement over previously used techniques. Author (TAB)

N70-18647# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
INTERDIFFUSION IN LEAD SELENIDE
Robert W. Brodersen, James N. Walpole, and Arthur R. Calawa Oct. 1969 25 p refs
(Contract N00014-67-A-0204)
(AD-697303; TR-3) Avail: CFSTI CSCL 20/12

A theoretical model was developed to explain the movement of a p-n junction in PbSe by the interdiffusion process. This model, which is a modification of an interdiffusion theory due to Brebrick, has one value for the diffusion coefficient in p-type material and another value in n-type material. Solutions to the diffusion equation for this model are obtained and compared to experimental interdiffusion data for PbSe at 400C obtained by the p-n junction method. The significance of the results to device fabrication and annealing is discussed. Author (TAB)

N70-18682*# Northrop Corporate Labs., Hawthorne, Calif.
STUDY OF DOPANTS FOR RADIATION-RESISTANT SILICON Quarterly Report
Jan. 1970 17 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952523)
(NASA-CR-108037; NCL-70-1R) Avail: CFSTI CSCL 20L

Minority carrier lifetime degradation by Co(60) gamma radiation was investigated in bulk silicon containing aluminum, boron, or diffused lithium. The results indicate that Al- and Li-doped materials are significantly more sensitive to this type of radiation than are comparable B-doped materials. These results are particularly surprising because they appear to contradict previous reports of enhanced radiation resistance of Al-doped bulk material and of Li-doped solar cells. One explanation for the apparent contradictory behavior of these materials may be the fact that their electrical properties are extremely sensitive to pre-irradiation heat treatments. The use of the proper treatment is consequently expected to influence the radiation response. Differences might also exist because of device effects not present in bulk material and because of dose and injection level dependences. Author

N70-18685*# Ohio State Univ., Columbus. ElectroScience Lab.
ELECTRON BEAM PUMPED LASER ACTION IN SELENIUM AND TELLURIUM WITH APPLICATIONS FOR TUNABLE BACKWARD PARAMETERIC OSCILLATIONS Semiannual Status Report
16 Jan. 1970 68 p refs
(Grant NGR-36-008-103)
(NASA-CR-108089; SASR-2679-3) Avail: CFSTI CSCL 20L

Growth of the nonlinear optical crystal, trigonal Se has continued and a crystal in the selinium telluride alloy was prepared. The absorption coefficient, refractive indices, and nonlinear susceptibility of these crystals are investigated. The cathodoluminescence experiments on Se were not active while the electron optics of the electron gun were being redesigned and rebuilt. Principal accomplishment was a detailed study of impurity or defect levels in grown and strained crystals of Se from thermally stimulated current measurements. Author

N70-18732*# National Aeronautics and Space Administration, Washington, D.C.
SOLID-STATE PHYSICS IN INTENSE MAGNETIC FIELDS
John A. Woollam *In its* Plasmas and Magnetic Fields in Propulsion and Power Res. 1970 p 183-202 refs (See N70-18726 07-25)
Avail: CFSTI CSCL 20L

This paper describes some of the physics experiments and some of the results which have engineering application. These include transport experiments, transistors in magnetic fields, magnetocaloric experiments, and a technique for plotting magnetic field lines in plasma containment magnets. Author

N70-18743*# Brown Univ., Providence, R.I. Div. of Engineering.
INVESTIGATION OF THE EFFECTS OF SUB-THRESHOLD HIGH ENERGY ELECTRONS ON THE PROPERTIES OF SILICON PHOTOVOLTAIC CELLS Midway Report, 3 Feb.-3 Aug. 1969
J. J. Loferski and E. E. Crisman Sep. 1969 23 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952386)
(NASA-CR-108094) Avail: CFSTI CSCL 20L

The effects of irradiating semiconductors by subthreshold electrons is reviewed. It is pointed out that lithium atoms dissolved in silicon would be displaced by electrons whose energy is less than 35 keV, whereas the electron must have about 150 keV to displace a silicon atom. Experiments designed to test this phenomenon are described. The effects of electron irradiation on semiconductor surfaces are also reviewed. Experimental apparatus for investigation of the effects of electrons irradiation in organic vapor free vacua (like those of outer space) on the characteristics of silicon photovoltaic cells is described. Author

N70-18748 California Univ., Berkeley.
EXCITATION, DETECTION, AND DISPERSION OF SURFACE ELASTIC WAVES IN PIEZOELECTRIC CRYSTALS
Shrinivas Govind Joshi (Ph.D. Thesis) 1968 171 p
Avail: Univ. Microfilms: HC $8.00/ Microfilm $3.00 Order No. 69-10319

The amplitude of the surface elastic wave produced by the application of an alternating voltage to an interdigital arrangement of electrodes on the surface of a piezoelectric medium is determined. The electric field produced by the surface electrodes is found by neglecting the piezoelectric coupling of the material. This electric field acts as the forcing term for the inhomogeneous elastic equation, which is then solved to obtain the amplitude of the surface wave generated by the transducer. A reciprocal relationship between the excitation and detection problems is used to obtain the power extracted from the surface wave by an interdigital arrangement of surface electrodes. Experimental measurements performed on single crystals of quartz and cadmium sulfide are found to be in good agreement with theoretical predictions. The dispersion relation for surface elastic waves propagating under a thin metallic grating on the basal plane of a hexagonal piezoelectric crystal is investigated theoretically. Dissert. Abstr.

N70-18841 Case Western Reserve Univ., Cleveland, Ohio.
DISLOCATION RELAXATION IN NIOBIUM AND NIOBIUM ALLOY SINGLE CRYSTALS
Maurice Francis Amateau (Ph.D. Thesis) 1968 215 p
Avail: Univ. Microfilms: HC $9.70/ Microfilm $3.00 Order No. 69-9388

Internal friction measurements over temperatures from 4 K to 400 K were made to study the dislocation relaxation phenomena in unalloyed niobium and in Nb-Mo, Nb-V, and Nb-Zr alloys. Single crystals deformed in tension to various amounts and at temperatures from 298 K to 77 K were studied at the frequencies of 100 khz and 20 mhz using resonant bar and pulse echo techniques. Torsion pendulum studies were also conducted on wire specimens swaged from single crystals. Two relaxation peaks identified as the alpha and beta-peaks which are characteristic of

bcc transition metals were found in unalloyed zone refined niobium and in niobium alloys containing up to 17 atomic per cent solute. The response of these peaks to deformation indicate that they result from intrinsic dislocation processes similar to the Bordoni peak in fcc metals. Dissert. Abstr.

N70-18887 Case Western Reserve Univ., Cleveland, Ohio
INFRARED SPECTROSCOPIC STUDIES OF THE POLYMERIC SOLID STATE
Donald Edward Witenhafer (Ph.D. Thesis) 1968 89 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-9444

The heat induced polymorphic transformation in Poly(3,3 bis(chloromethyl)oxacyclobutane) (Penton) is discussed in terms of the independent domain and nucleation theories. The crystal structure and unusual annealing behavior of Penton single crystals are discussed. Changes in the fold structure during the annealing of linear polyethylene are followed using the absorbance ratio of the 1304 and 1350 cm/1 bands. An infrared band sensitive to order in polyacrylonitrile is reported. Dissert. Abstr.

N70-18907 California Univ., Berkeley.
PRECIPITATION OF VACANCIES IN QUENCHED ALUMINUM
Jean-Loup Bernard Victor Strudel (Ph.D. Thesis) 1968 101 p
Avail: Univ. Microfilms: HC $5.20/Microfilm $3.00 Order No. 69-10391

The major goal of this work was to study the influence of the quenching temperature and the aging temperature on the nucleation and growth of Frank loops and octahedral voids and to determine the conditions favoring the nucleation of voids over loops. The samples were quenched from 425 C, 475 C, 525 C or 575 C to -110 C and then pulsed to aging temperatures ranging from -40 C to + 100 C. Isothermal annealing curves were obtained by resistivity measurements at liquid helium temperature. Voids and dislocation loops were present in every case in different proportions with sizes ranging from 40 A to 500 A for the voids and 100 A to 6000 A for loops. The use of (110) single crystals facilitated the observation of very small voids. The results suggest that precipitation of supersaturated vacancies in secondary defects proceeds by a coarsening mechanism. A qualitative interpretation of these results and others is presented and suggestions are made for a more quantitative model. Dissert. Abstr.

N70-18926 Maryland Univ., College Park.
THE VIBRATIONAL SPECTRA OF HIGH PRESSURE SOLIDS
Robert John Obremski (Ph.D. Thesis) 1968 224 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 69-9326

Diamond cell instrumentation was used to apply high pressure to BF3-NH3 to aid in a vibrational assignment and to determine whether or not a hydrogen-bond exists in the compound. The infrared spectra recorded on high pressure samples indicate that no hydrogen bond is present in the solid. The assignment of the vibrational spectra of BF3-NH3 has also been made utilizing the effects of high pressure on the mid-infrared bands (4000-200/cm) and noting the Raman and infrared activity of bands in the range 4000-40/cm. Thus, crystal structures of solid modifications of room temperature liquids have been determined, and a vibrational assignment of the simple coordination compound BF3-HN3 has been made utilizing pressure techniques. Dissert. Abstr.

N70-18960*# Fairfield Univ., Conn.
INVESTIGATION OF ENERGY AND DEPOSITION PROCESSES IN THE UPPER ATMOSPHERE AND THE INTERACTION BETWEEN THE MESOSPHERE AND THE THERMOSPHERE Annual Progress Report, 1 Mar. 1968-1 Jun. 1969
James H. Mc Elaney Jun. 1969 14 p refs
(Grant NGR-07-010-002)
(NASA-CR-108227) Avail: CFSTI CSCL 20L

The purpose of this present work is to investigate the effects on the transmittance of optical materials commonly used in the ultraviolet when subjected to irradiation with high energy protons. The radiation dose is what might be encountered in space in a Nimbus satellite orbit in the course of a year. This study is a continuation of the work of Heath and Sacher on the effects of high energy electrons on the transmittance of optical materials. It is also a continuation of, and supercedes, the work of Sacher on the effects of proton irradiation on optical materials. This study has been limited to materials which are transparent in the ultraviolet region of the spectrum, from 1050 A to 3000 A. Author

N70-18970 Syracuse Univ., N.Y.
A STUDY OF SOME HALIDES AND THE OXIDES OF SAMARIUM, EUROPIUM AND GADOLINIUM
Henry Howard Thomas, Jr. (Ph.D. Thesis) 1968 140 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-7784

An exploratory investigation in the spectroscopic and magnetic properties of several anhydrous rare earth metal halides was conducted. The primary aim was the study of the effect crystal field splitting had on these properties. In particular, it was of interest to determine if crystal field effects could be observed in static susceptibility measurements. The metals selected were gadolinium, europium, and samarium. The compounds prepared were GdBr3, SmBr3, and NdBr3, and the divalent compounds EuBr2, EuCl2, SmCl2 and SmBr2. The following compounds were obtained commercially: EuF3, EuCl3, SmF3, SmCl3, GdF3 and GdCl3. In an effort to determine crystal symmetries the crystal structures of EuBr2, SmBr2, and GdBr3 are determined from X-ray powder data. These compounds had not been studied in detail previously. The results of pycnometer density measurement results are presented. They support the values determined from the X-ray data. Dissert. Abstr.

N70-18991# Utah Univ., Salt Lake City. Div. of Materials Science and Engineering.
BAND STRUCTURE AND TRANSPORT COEFFICIENTS OF V-VI COMPOUND SEMICONDUCTORS AND THEIR ALLOYS Final Report
Gerald R. Miller Sep. 1969 128 p refs
(Contract N00014-67-A-0325-0002)
(AD-696244; UTEC-MSE-69-1) Avail: CFSTI CSCL 20/12

This report is presented in two main sections. Section II describes some successful experimental work which removed discrepancies between de Haas-van Alphen and galvanomagnetic measurements on Bi2Te3 and indicates the existence of a higher lying conduction band minima. Work on Bi2Se3 indicates the almost spherical nature of the six valley conduction band. In section III, a calculation of the electron and hole spectra of Bi2Te3 via the empirical pseudopotential method, is given. This calculation, done with the only amenable method for such a complex compound was successful in predicting the correct number of valence and conduction band extremes as well as showing the need for careful inclusion of the spin-orbit terms. Author (TAB)

N70-18997 Pennsylvania State Univ., University Park.
DIELECTRIC RELAXATION IN STRONTIUM TITANATE-RARE EARTH TITANATE SOLID SOLUTIONS
David Wilfred Johnson (Ph.D. Thesis) 1968 137 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-9770

Dielectric relaxation studies were made of solid solutions of B(3+) or La(3+) in SrTiO3. The entire series of trivalent rare earth ions were examined as dopants for SrTiO3. If these rare earths produced relaxation, the additional data might help to determine more clearly the mechanisms of relaxation in high permittivity materials. Polycrystalline samples were made by reacting carbonates

and oxides, cold pressing, and sintering. X-ray diffraction was used to determine solubility limits and unit cell parameters. Permittivity data was taken. Hysteresis, pyroelectric, and conductivity measurements were also made on polycrystalline samples. The results were examined in the light of three current models for explaining dielectric relaxation in high permittivity materials.
Dissert. Abstr.

N70-19008*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN ELECTRON PARAMAGNETIC RESONANCE STUDY OF THE ORDER IN SEVERAL NEMATIC LIQUID CRYSTALS
George C. Fryburg and Edward Gelerinter (Kent State Univ.) Washington Feb. 1970 13 p refs
(NASA-TN-D-5659; E-5392) Avail: CFSTI CSCL 20B

The molecular ordering in four nematic liquid crystals has been studied as a function of temperature by using an electron paramagnetic resonance technique. The degree of order should be a universal function of the reduced temperature according to Saupe's model. Deviations from this model were observed. The degree of order at any given reduced temperature seemed dependent on the nematic-isotropic transition temperature: the higher the transition temperature, the lower the degree of order. One of the liquid crystals, bis (4'-n-octyloxybenzal)-2-chloro-1, 4-phenylenediamine, exhibited an unusually high degree of order in the lower part of its mesophase. In addition, the EPR lines assumed a peculiar asymmetric appearance. These features can be explained in terms of a model in which the liquid crystal becomes viscous in the lower part of its mesophase.
Author

N70-19101*# Illinois Univ., Urbana. Coordinated Science Lab.
TUNNELING SPECTROSCOPY IN p-TYPE SILICON
Donald Edward Cullen (Ph.D. Thesis) Sep. 1969 144 p refs
(Contracts DAAB-07-67-C-0199; JPL-952383)
(NASA-CR-107939; AD-694304; R-456) Avail: CFSTI CSCL 20L

Tunneling in boron doped p-type silicon metal-semiconductor and metal-insulator-semiconductor tunnel junctions has been studied at low temperatures by measuring the derivatives, DI/D V and the second derivative of I with respect to V, of the current-voltage characteristics as functions of applied bias voltage V. The junctions were prepared by evaporating metal contacts onto vacuum and air cleaved silicon surfaces. The general features of the tunneling conductance were found to be in qualitative agreement with existing theories of tunneling in semiconductors. Structure in the derivative data resulting from the interaction of tunneling electrons with silicon zone center optical phonons and boron local-mode phonons has been observed. The optical phonon lineshapes in the most heavily doped MIS units are shown to compare well with the theoretical lineshapes in which modifications in the bulk semiconductor states arising from electron-optical phonon interactions in the semiconductor electrode have been included. Anomalous zero-bias conductance minima were observed in the tunneling characteristics of the silicon MS junctions. At least a part of this structure is attributed to intermediate state tunneling whereby electron tunnel from one electrode to the other in two steps via intermediate states localized in the depletion region of the semiconductor. The source of the remaining structure is not known.
Author (TAB)

N70-19109# Illinois Univ., Urbana. Electrical Engineering Research Lab.
INTERFACE AND BULK PHENOMENA IN SOLID STATE SCIENCE Final Scientific Report, 15 Sep. 1966-14 Sep. 1969
C. T. Sah 14 Oct. 1969 12 p refs
(Grant AF-AFOSR-714-67)
(AD-696258; AFOSR-69-2733TR) Avail: CFSTI CSCL 20/12

The electrical properties of surface states at the interface of silicon diodes and silicon have been studied using the small signal admittance measurements on metal-oxide-silicon capacitor structures over wide ranges of signal frequency, temperature, oxide thickness and oxidation conditions. Ellipsometry techniques are set up for the thin oxide region. Detailed studies have been made to correlate the 1/f noise power spectra with interface state density and carrier cross-sections. Orientation and size effects of carrier scattering at the interface have been observed from 4 to 300 degrees K and correlated with the quantum and classical models, including mobility anisotropy. A two dimensional analysis of the saturation electrical characteristics of surface channel and surface field-effect transistor structures has been verified by experiments.
Author (TAB)

N70-19203 Pennsylvania State Univ., University Park.
DIELECTRIC PROPERTIES OF STRONTIUM TITANATE AT LOW TEMPERATURES
Mansoor Ali Saifi (Ph.D. Thesis) 1968 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-9798

Optical studies in polarized light showed that the crystal goes through a phase transition at 111.5 K. The orientations of the twinned regions observed in the low temperature phase were compatible with tetragonal symmetry. The weak field dielectric constant of the Verneuil grown crystals was measured in the three crystallographic directions [100], [110], and [111]. For fields of the order of 1 kV/cm the constant has a broad maximum as a function of temperature. At low temperatures strontium titanate was found to be a highly nonlinear dielectric. An annealing procedure was developed to reduce the strains and the large dislocation densities found in the Verneuil grown crystals. The dielectric properties of the annealed crystals in the [100] orientation were investigated. At low temperatures the weak field dielectric behavior of the annealed crystal was found to be considerably different from that of the unannealed crystal. Thermodynamic phenomenological analyses were also carried out. Results suggest that in pure strain-free single crystals of $SrTiO_3$, there is a phase change in the region of 62.5 K to an antiferroelectric stable state.
Dissert. Abstr.

N70-19207 Carnegie-Mellon Univ., Pittsburgh, Pa.
ZnSe-Ge HETEROJUNCTIONS AND HETEROJUNCTION TRANSISTORS
Harold John Hovel (Ph.D. Thesis) 1968 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 69-6584

Single crystal epitaxial layers of ZnSe are produced on Ge using the HCl close-spaced system. The thermodynamics of the process are described, and growth habits of the epitaxial layers are shown, with the best layers produced at the lowest HCl concentrations and growth rates. Cracking due to thermal and lattice mismatches is eliminated by a slow-cooling process. Doping is accomplished using heavily doped source material and diffusion of Zn from the vapor to eliminate compensating Zn vacancies. Components of current contributing to the forward characteristics of nZnSe-pGe diodes are discussed. The common-emitter current gain of heterojunction transistors is described. The injection efficiency is limited by the capture-tunneling of electrons through the ZnSe depletion region and by recombination at the interface. The transport factor is determined by the base transit time and lifetime.
Dissert. Abstr.

N70-19327*# Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.
CERTAIN QUESTIONS CONCERNING DIFFUSION THEORY [NEKOTORYYE VOPROSY TEORII DIFFUZII]
M. A. Krishtal et al Washington NASA Feb. 1970 23 p refs Transl. into ENGLISH from Zashchitn. Pokrytiya Na Metallakh (USSR), no. 2, 1968 p 7–28
(Contract NASw-1692)
(NASA-TT-F-12809) Avail: CFSTI CSCL 20L

Diffusion theory may be divided into three major categories: the mechanism and kinetics of diffusion, the thermodynamics of

diffusion and the influence of structure on diffusion mechanisms are described, followed by a detailed discussion of their role in self-diffusion and heterodiffusion, both in general and with respect to specific metals and metal systems. Briefly noted are certain special diffusion mechanisms, thermal diffusion and the correlation factor as applied to certain cases. The influence of structure on diffusion and the important metallurgical question of the concentration-dependence of the diffusion coefficient are dealt with. Comparisons between theory and experimental findings are drawn in all the areas discussed. Author

N70-19332 California Univ., Berkeley.
THERMAL RADIATION PROPERTIES OF COMPACTED ALUMINA POWDER
Marnix Fritz Eugen Dillenius (Ph.D. Thesis) 1968 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 69-10278

The two-flux model is used to represent the actual radiation field in a partially absorbing and scattering medium provided by a compacted powder. Radiation performance factors such as the spectral reflectance and transmission are derived using different types of boundary conditions. The system constants required by the two-flux model are related to the commonly known and measured absorption and scattering coefficients determined by the single particle theory as developed by Mie. The effect of slightly rough interfaces is incorporated in the appropriate boundary condition and the basic two-flux model is studied also in regard to its ability to satisfy Kirchoff's law and the reflectance reciprocity law. Dissert. Abstr.

N70-19417# Minnesota Univ., Minneapolis. School of Physics.
EXPERIMENTAL AND THEORETICAL STUDIES IN SOLID STATE AND LOW TEMPERATURE PHYSICS Annual Progress Report, 1969
Sep. 1969 26 p refs
(Contract AT(11-1)-1569)
(COO-1569-45) Avail: CFSTI

Research is reported on the following; superconductivity, theory of quantum crystals, theory of liquid He, quantum hydrodynamics of superfluid He, lambda transition in He-3-He-4 mixtures, magnetism in metals, and magnetic properties of crystalline He-3. NSA

N70-19441 Texas A&M Univ., College Station.
ELECTROGRAVIMETRIC TRACE ANALYSIS ON A PIEZOELECTRIC DETECTOR
James Philip Mieure (Ph.D. Thesis) 1968 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-8493

The fundamental frequency of a piezoelectric crystal is dependent upon its mass. Very small changes in the active mass of the crystal can be observed by following the frequency of an oscillator controlled by that crystal. When quartz crystals with vacuum-plated metallic film electrodes were used as the working electrode in an electrodeposition circuit, the frequency changes of the crystals were found to be proportional to the amount of material deposited. When electrodeposition was conducted over constant time intervals, the amount of metal deposited during an interval was proportional to the initial metal ion concentration. Linear working curves showing frequency changes as functions of the initial metal ion concentrations, for given sets of conditions, were found to be suitable for quantitative analysis. A detailed procedure is presented which describes a novel method for the determination of very low concentrations of cadmium, nickel, zinc, indium, and lead in aqueous solutions. Dissert. Abstr.

N70-19480# Minnesota Univ., Minneapolis. School of Physics.
THERMAL FLUCTUATIONS AND THE JOSEPHSON SUPERCURRENT
J. T. Anderson and A. M. Goldman [1968] 17 p refs
(Contract AT(11-1)-1569)
(COO-1569-40) Avail: CFSTI

Fluctuations can play an important role in determining the behavior of Josephson junctions when the coupling energy across the junction is of the order of thermal energies. This situation can be realized near the critical temperature and near the minima of the I sub 1(H) curve at low temperatures. In these regimes the effects of thermal fluctuations on the I-V characteristic are quite dramatic. Using a carefully shielded, thermally regulated apparatus, the I-V characteristic of an almost ideal Josephson junction was measured in both of these regimes. The results are in qualitative agreement with calculations which treat the problem of thermal fluctuations in a junction, using an analogy with the Brownian motion of a particle in a field of force. Author (NSA)

N70-19546# Los Alamos Scientific Lab., N.Mex.
IMMERSION SPECTROPHOTOMETRY OF VAPOR-DEPOSITED INTERFERENCE FILMS
Ann D. Mulford and W. P. Ellis Jun. 1969 18 p refs
(Contract W-7405-eng-36)
(LA-4206) Avail: CFSTI

The refractive index of magnesium fluoride as determined by the immersion spectrophotometric method is an integrated index which depends on the degree of heterogeneity within the film. This index changes with time because vapor-deposited films undergo aging, a process of recrystallization brought about by the inherent stresses. The foregoing factors can be minimized in films made by very rapid deposition and then vacuum-stabilized. Author (NSA)

N70-19597# Minnesota Univ., Minneapolis.
SUPERCONDUCTING FLUCTUATION ROUNDING OF THE RESISTIVE TRANSITION OF NB.88 TI.12 N FILMS
A. M. Goldman, F. M. Scheer, L. E. Toth, and J. Zbasnik [1969] 14 p refs
(Contract AT(11-1)-1569)
(COO-1569-39) Avail: CFSTI

A detailed study of the resistive transition of Nb.88Ti.12N films was performed from 10 to 50 K to test the theory of superconducting fluctuations. A crucial prediction of this theory is a change in the temperature dependence of the resistance corresponding to a change in the ratio of the film thickness to the temperature-dependent coherence length. Evidence of observation of this transition is presented. The value of the Aslamazov-Larkin parameter is about 1/3 the value computed from the normal sheet resistance of the film. A remarkable feature of the transition is that the superconducting fluctuations possibly affect the resistivity at temperatures as high as 33 K. Author (NSA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N70-18642# Federal Aviation Administration, Washington, D.C. Office of Supersonic Transport Development.
FUEL CONSIDERATIONS IN THE US SUPERSONIC TRANSPORT PROGRAM
Joseph C. Saia 24 Oct. 1968 28 p refs Presented at the Jet Fuel Quality Symp., San Antonio, 22-24 Oct. 1968
(AD-696588) Avail: CFSTI CSCL 21/4

The type of fuel selected for use in the United States Supersonic Transport (SST) is commercial Jet A kerosene. The importance of the fuel cost factor in SST direct operating cost, and

the reasons for excluding the use of commercial Jet B aviation turbine fuel for the SST, are briefly discussed in this paper. A general description of the SST aircraft and engine fuel systems, and the typical environmental conditions to which the fuel will be exposed, are included. The SST fuels test programs are summarized. Author (TAB)

N70-18543# Explosives Research and Development Establishment, Waltham Abbey (England).
THE TENSILE PROPERTIES OF PLASTIC PROPELLANT RD2404/LOT 19
R. W. Bryant, W. A. Dukes, and R. A. Gledhill 17 Mar. 1969 18 p refs
(AD-696465; ERDE-5/M/59) Avail: CFSTI CSCL 21/9.2

A sample of plastic propellant RD2404/Lot 19 has been characterized in uniaxial tension using WLF time-temperature superposition principles, over a temperature range of -60 to +60 degrees C, and a strain-rate range of 0.1 to 10 to the minus 1. A glass transition temperature of -85 degrees C is indicated on this basis. The effective gauge-length for ERDE dumb-bells of this propellant is 56 mm, between +60 to -40 degrees C. At -60 degrees C it is more than doubled. Ratios of the propellants extensibility at -30 and -40 degrees C enable the derivation of the degree of stiffening of the rocket motor case required if it is to function at the lower temperature with a safety factor similar to that at the higher. Author (TAB)

N70-18547# Institute for Defense Analyses, Arlington, Va.
POWER REQUIREMENTS: SIMILITUDES AND LIMITATIONS IN TRANS-CONVENTIONAL PROPULSION SYSTEMS
George C. Szego *In* AGARD Space Power Systems, Pt. 1 Nov. 1969 p 1-19 refs (See N70-18546 07-03)
Avail: CFSTI

The aspect of extending the performance requirements of a given vehicle system for a certain space mission is analyzed for space flight from the booster upwards. The only fruitful area for improving rocket performance is considered to be the increase in relative exhaust velocity of the specific impulse derived by the expellant. Topics discussed are: (1) nonredox energy sources, (2) free radicals as high energy sources, (3) generalized relationships of electrical propulsion, and (4) optimization of specific impulses for a space vehicle. It is concluded that to optimize a space vehicle more fully, combined considerations must be made of the total requirements from the earth's surface to final destination, and the results depend on the mission. F.O.S.

N70-18825*# Florida Univ., Gainesville. Coll. of Engineering.
CHARACTERISTICS OF LIQUID ROCKET PROPELLANT EXPLOSION PHENOMENA. PART 8, NO. 448: PREDICTION OF EXPLOSIVE YIELD AND OTHER CHARACTERISTICS OF LIQUID PROPELLANT ROCKET EXPLOSIONS
Erich A. Farber Nov. 1969 41 p refs Presented at the Cryog. Eng. Conf., Los Angeles, 16-20 Jun. 1969 and at the 11th Ann. Explosives Safety Seminar, Memphis, 9-10 Sep. 1969 *Its* Tech. Paper Ser. Vol. 23, No. 11
(Contract NAS10-1255)
(NASA-CR-107231) Avail: CFSTI CSCL 21I

This paper describes the work on the characteristics of liquid propellants. Three independent methods were developed describing the phenomena, and are useful in the prediction of explosive yield: (1) the mathematical model, (2) the seven chart approach, and (3) the critical mass method. These methods are described briefly. In addition to the above work the following phenomena are described: the time sequenced phenomena from the mode of failure of a particular missile, through mixing of the propellants; ignition; formation of the shock and reaction fronts; their propagation and separation; their interaction with missile tankage, their emergence into the atmosphere; formation of the fireball; the fireball growth, and cooling with the resulting combustion products cloud with its composition. Author

N70-18939# Utah Univ., Salt Lake City. Coll. of Engineering.
DYNAMIC MEASUREMENT OF SHOCK INTENSITY IN VISCOELASTIC MATERIALS Final Report
Glenn A. Secor and Max L. Williams Oct. 1969 104 p refs
(Contract DAAH01-67-C-1441)
(AD-697175; UTEC-DO-69-134) Avail: CFSTI CSCL 21/9.2

This report presents results obtained in a series of studies concerning wave propagation in solid propellants and methods of investigating that topic. Uniaxial and cylindrical wave propagation experiments were performed in Solithane 113 and in an inert propellant. The experiments in Solithane 113 were studied using photoelasticity to investigate the usefulness of that material and technique for wave propagation experiments. The experiments in inert propellant were used to predict the early time characteristics of the material. Magnetic velocity transducers were used in these studies. Author (TAB)

N70-19236 Wisconsin Univ., Madison.
EXPERIMENTAL AND THEORETICAL STUDIES OF BURNING DROPS OF HYDROCARBON FUELS
Charles Shin-Yang Chen (Ph.D. Thesis) 1968 138 p
Avail: Univ. Microfilms: HC $15.30/Microfilm $4.35 Order No. 68-15972

This is a study of the self-ignition and burning behavior of drops of heavy hydrocarbon mixtures. The burning irregularity was found to be mostly attributable to the asphaltenes and, to a lesser extent, the heavy unstable resin components. In the experiments, drops were suspended on fine thermocouple beads and suddenly subjected to heated air streams after which they self ignited. These experiments allowed temperature, flame, and size histories to be obtained. However, due to the thermal decomposition and irregular burning, the mass histories could not be directly obtained from experimental size and temperature data since the liquid densities are not sole functions of temperature but also of shape and decomposition constituents. Dissert. Abstr.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N70-18446# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TESTING OF AIRCRAFT AIR-BREATHING JET ENGINES
G. M. Gorbunov et al 11 Jul. 1969 127 p refs Transl. into ENGLISH from Ispytaniya Aviats. Vozdushno-Reaktivnykh Dvigatelei, (Moscow), 1967 p 1-95
(AD-696168; FTD-MT-24-149-68) Avail: CFSTI CSCL 21/5

Contents: Conditions, characteristics of the air-breathing jet engine and classification of tests; Methods of determining the lifespan and criteria of operational reliability of aviation engines; Test stations and installations for the test of full-scale air-breathing jet engines; and Installation and test stands for testing subassemblies and units of the air-breathing jet engines. TAB

N70-18508# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
REGENERATIVE COOLING FOR COMBUSTION CHAMBERS AND ENGINE NOZZLES WITH SUPERCRITICAL HEAT TRANSFER [REFROIDISSEMENT PAR REGENERATION

DES CHAMBRES DE COMBUSTION ET DES TUYERES DE MOTEURS-FUSEES EN REGIME DE TRANSFERT DE CHALEUR SUPERSONIQUE]

Yu. P. Yakovlev [1969] 8 p refs Transl. into FRENCH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), No. 3, 1968 p 147 – 149 In FRENCH and RUSSIAN
(LRBA-69-0456) Avail: CFSTI

External cooling of the combustion chamber and nozzle takes place to a considerable extent by boiling of the fluid in the wall layer. When wall temperature reaches saturation temperature, bubbles begin to form on the wall, which upon separating from it and condensing in the cold air stream, intensively mix with the boundary layer and reduce its thermal resistance, i.e. the heat transfer coefficient is increased. With a further increase in the thermal flow, the intensive formation of bubbles on the wall results in the bubbles fusing into a uniform vapor film which insulates the wall from the fluid. There is a transition to film boiling in which the heat transfer coefficient decreases sharply and the wall temperature increases sharply. The critical point is reached and the temperature jump is so great that the chamber wall disintegrates. The wall disintegration can be prevented by using diathermic materials for the inner wall of the engine, which pass the heat through the wall directly into cooling fluid, thus concentrating the thermal flow in the fluid itself rather than in the boundary layer.
Transl. by R.B.

N70-18645*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RESEARCH AND DEVELOPMENT IN NEEDLE AND SLIT COLLOID THRUSTERS
Kenneth W. Stark and Allan Sherman Washington Feb. 1970 39 p refs
(NASA-TN-D-5303) Avail: CFSTI CSCL 21H

A thorough test program was conducted to obtain familiarity with and proficiency in capillary needle colloid thruster technology. This technology is basically a means by which electrostatic particle spraying can be achieved through the use of slightly conductive propellants and high voltages. Forty-eight single needle tests were run with various needle materials and geometries, using several propellant combinations. Several test facility variations were employed to study secondary electron effects. From the results of these tests, an optimum configuration of needle material, needle geometry, propellant composition, needle-to-collector distance and high voltage to be used was obtained. During this time two slit colloid thruster sources were designed and built. After the single needle testing was terminated, the annular slit thruster was tested successfully. Future efforts will concentrate on continued testing of the annular slit thruster to perfect its overall performance. Author

N70-18704*# TRW Systems Group, Redondo Beach, Calif.
APOLLO LUNAR MODULE DESCENT ENGINE ABLATIVE CHAMBER - INJECTOR COMPATIBILITY IMPROVEMENT STUDY Final Report
24 Dec. 1969 337 p refs
(Contract NAS8-8229)
(NASA-CR-102177; TRW-11602-6039-R0-00) Avail: CFSTI CSCL 21H

Major accomplishments reported are: (1) detailed analytical and experimental evalustion of the current descent engine chamber wall environment and the correlation of this environment with the resultant thrust chamber overall durability/throat erosion; (2) determination of variations in thermal environment as functions of internal chamber contour, injector flow distribution, barrier coolant flow, and engine thrust level; (3) analytical evaluation and experimental confirmation of improved ablative chamber materials and chamber designs; (4) verification testing of an improved descent engine thrust chamber design (internal contour and material) in a flightweight configuration, with a significant reduction in throat erosion even though the duty cycle duration was increased by 10 percent; and (5) incorporation of the improved chamber liner material into the mainline LMDE chamber with a significant reduction in throat erosion over the extended duty cyle. Author

N70-18758# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
ACOUSTICAL CONDUCTIVITY OF A PIPELINE WITH CONTROL UNITS IN THE FEED SYSTEM OF AN ENGINE [CONDUCTIBILITE ACOUSTIQUE DE L'ENSEMBLE DE LA TUYAUTERIE ET DES ORGANES DE REGULATION DANS LES SYSTEMES D'ALIMENTATION DES MOTEURS]
I. A. Dobodeich et al [1969] 17 p refs Transl. into FRENCH from Izv. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1968 p 70-76 In FRENCH and RUSSIAN
(LRBA-69-1212) Avail: CFSTI

The flow system of a pipeline connected in series is considered, the various sections of which are of different length and cross sections, and which has different boundary conditions determined by the type of assemblies switched into the system. The parameters of the assemblies are assumed to be centralized, but they may be both constant and variable in time. The principles governing variations in pressure and flow velocity at any point in the system are determined for the presence of an independent exciter of pressure vairations at one point. Transl. by R.B.

N70-18760*# General Electric Co., Philadelphia, Pa. Isotope Power Systems Operation.
A DESIGN STUDY FOR A MAGNETOHYDRODYNAMIC POWER SYSTEM FOR A NUCLEAR ELECTRIC PROPELLED UNMANNED SPACECRAFT Midterm Report, 26 May-25 Dec. 1969
Dec. 1969 102 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952415)
(NASA-CR-108085; GESP-7025) Avail: CFSTI CSCL 21C

This report discusses the progress made in the first half of a one-year design study of nuclear-electric propelled unmanned spacecraft using a magnetohydrogynamic (MHD) power system. The study guidelines and approach are defined here, and the characteristics of one launch vehicle, the thruster subsystem, and the payload and communications system are presented. The MHD power conversion system is described and mathods used to calculate MHD system parameters are discussed. This report includes a discussion of the arrangement and structural arguments used to select system configuration. The system startup technique is identified, and the detailed design and weight summary of the baseline 300 kWe system are presented. Author

N70-18941*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY EVALUATION OF A PERFORATED SHEET FILM-COOLED LINER IN A TURBOJET COMBUSTOR
James S. Fear Nov. 1969 17 p refs
(NASA-TM-X-52705) Avail: CFSTI CSCL 21E

The performance of a turbojet combustor with a perforated sheet film-cooled liner was compared with the performance of the same combustor with a conventional stepped continuous-slot film-cooled liner. Both combustors used a jet-type fuel conforming to ASTM A-1 specifications. Tests were conducted at near atmospheric pressure, with combustor inlet air temperatures at 600 F (589 K), and combustor average exit temperatures up to 2368 F (1571 K). The perforated sheet film-cooled liner performed its function well and had no detrimental effects on combustion efficiency, total pressure loss, or exit radial temperature profile. Author

N70-19506# Technische Univ., Berlin (West Germany). Lehrstuhl und Inst. fuer Luftfahrttriebwerke.
PERFORMANCE OBSERVATIONS OF AIRCRAFT ENGINES DURING FLIGHT Report No. 1 To The Allied Command,

Berlin [LEISTUNGSUEBERWACHUNG VON LUFTFAHRTTRIEBWERKEN IM FLUGE]
Otto David 30 Sep. 1969 25 p In GERMAN
Avail: CFSTI

Theoretical and experimental work on flight performance control of turbojet engines concentrated on a single stage propulsion system without afterburner and with a stable geometry. A planned error simulation is obtained by including certain system paramaters in the control of aero-thermodynamic engine functions. Quantitative and qualitative effects of variations in design parameters on approximative values, technical measurement problems of turbojet engine control, and accuracy requirements for applied sensors are projected. G.G.

N70-19647# Laboratoire Recherches Balistiques et Aerodynamiques, Vernon (France).
CALCULATIONS OF GAS CYLINDER PRESSURIZATION SYSTEM WITH HEATED GAS [CALCUL DES SYSTEMES DE PRESSURISATION A BOUTEILLE DE GAZ COMPRIME AVEC RECHAUFFAGE DU GAZ A LA SORTIE DE LA BOUTEILLE]
V. I. Esin [1969] 12 p refs In FRENCH and RUSSIAN
(LRBA-69-0961) Avail: CFSTI

A gas cylinder system of pressurization is analyzed in which fuel is displaced from a vessel assuming a constant volume of fuel consumption. High pressure gas from the cylinder is fed to the vessel through a gas pressure regulator or through a jet having a uniform cross section. Pressurization system effectiveness is enhanced by supplementary heating the gas exiting from the cylinder. Equations are derived for pressure variations in the cylinder and the vessel. Transl. by E.C.

N70-19648# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
SELECTION OF CONICAL NOZZLE PARAMETERS FOR SUPERSONIC TURBINES [CHOIX DES DIMENSIONS DES TUYERES CONIQUES POUR TURBINES SUPERSONIQUES]
O. N. Emin and K. A. Kapitonova [1969] 18 p refs In FRENCH and RUSSIAN
(LRBA-69-0959) Avail: CFSTI

The effects of fundamental geometrical characteristics of conical expanding nozzles were investigated, particularly the critical and exit sections and the angle of the transverse section. For the design of single expanding nozzles for axial turbines operating in a wide range of degrees of expansion, it was found that the fundamental nozzle dimensions should be governed by the smallest degree of expansion based on the time of each turbine cycle. The minimum value of the transverse angle of the supersonic nozzle should be within the limits a = 14 to 17 degrees. Transl. by E.C.

N70-19650# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
ANALYTICAL METHOD FOR DETERMINING SOLID PROPELLANT ENGINE PERFORMANCE EFFECTIVENESS USING TEST DATA [ANALYSE DE L'EFFICACITE DES PROPULSEURS A POUDRE D'APRES LES RESULTATS D'ESSAIS CLASSIQUES]
Z. P. Belkina, M. M. Maslennikov, and M. S. Rapiport [1969] 17 p In FRENCH and RUSSIAN
(LRBA-69-0172) Avail: CFSTI

A method was formulated for obtaining an approximate estimate of solid propellant engine performance using conventional test data. The method is suitable for homogeneous fuels with known thermodynamic constants of combustion products. For burnout of metal cladding and thermal insulator materials, averaged physical constants are used. Transl. by E.C.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N70-18559*# Pittsburgh Univ., Penn. Space Research Coordination Center.
ROCKET INVESTIGATION OF THE AURORAL GREEN LINE
T. D. Parkinson, E. C. Zipf, and T. M. Donahue 15 Oct. 1969 26 p refs
(Contract NASr-179; Grant NGL-39-011-179)
(NASA-CR-108092; SRCC-107) Avail: CFSTI CSCL 04A

Results obtained from rocket borne photometers, electron energy analyzers and ion mass spectrometers show that direct excitation of atomic oxygen by auroral electrons can excite only a small fraction of the auroral green line observed. From measured ion distributions, dissociative recombination of O2(+) is shown to contribute only weakly to the excitation of O(1S) except at high altitudes. It is proposed here that dissociative excitation of O2 can account for the major portion of the production of O(1S) if the cross section for the process is of order 10 to the minus 16th power sq cm. Dissociative recombination supplements this mechanism at high altitude and produces about 10 per cent of the total emission. Author

N70-18638*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
Mn-53 AND THE AGE OF GALACTIC COSMIC RAYS
Donald V. Reames Jan. 1970 10 p refs Submitted for publication
(NASA-TM-X-63814; X-611-70-5) Avail: CFSTI CSCL 03B

A new measurement is suggested for obtaining information on the mean age of the galactic cosmic rays. The technique is based on approximately 2 × 10 to the 6th power year half life of Mn-53 which may be produced copiously below 200 MeV nucleon by the fragmentation of cosmic ray Fe-56 during its passage through interstellar hydrogen. Author

N70-18641*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LOW FREQUENCY COSMIC NOISE OBSERVATIONS OF THE CONSTITUTION OF THE LOCAL SYSTEM
J. K. Alexander, L. W. Brown, T. A. Clark, and R. G. Stone Jan. 1970 20 p refs
(NASA-TM-X-63817; X-615-70-22) Avail: CFSTI CSCL 03B

Based on measurements of the low frequency continuum radiation of the galaxy, estimates were obtained for the gross distribution of thermal electrons, the synchrotron radiation emissivity and the flux and spectrum of low energy cosmic ray electrons for the interstellar medium in the local system. The volume emissivity of the synchrotron radiation at 1 MHz is 10 to the -39 W/(cu m Hz sr). This value exceeds the emissivity deduced from measurements at higher frequencies over longer path lengths and in turn implies a low magnetic field between spiral arms (= or < 1 microgauss). For a mean interstellar magnetic field of 3 microgauss near the sun, the radio data indicate a cosmic ray electron intensity at 0.3 Gev of 1000 el/sq m sec sr GeV). That this intensity exceeds the value obtained from direct measurements by a factor of approximately 100 suggests either a large residual solar modulation or gradients in the interstellar distribution of cosmic rays. Author

N70-18689# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
PROJECT AURECHOES: AURORAL ECHOES AND THE TWO-STREAM INSTABILITY Final Report
Harold G. Camnitz, Roland T. Tsunoda, and Daniel A. Barclys Sep. 1969 112 p refs

(Contract N00014-67-C-0409)
(AD-697312; CAL-RG-2460-P-1) Avail: CFSTI CSCL 4/1

The literature indicates that the two-stream instability is an important causal mechanism in the production of electron-density irregularities which contribute to aspect-sensitive VHF echoes from the equatorial and auroral E regions. The two-stream-theory relationship between Doppler shift and radar frequency computed by D. T. Farley for the equatorial E region is scaled so as to represent an auroral environment at any temperature. Salient characteristics of 158 Doppler spectra, obtained during 143.5-MHz auroral backscatter experiments at Buffalo, are listed and discussed. Approximately 54% of these spectra have a single peak; the appearance of two peaks in 40% of the spectra probably resulted mainly from nonuniformities in the auroral current systems. The characteristics observed by us of spectral peaks centered on Doppler velocities from 325 to 800 m/s are consistent with predictions from the two-stream theory; the range in values of these Doppler velocities is probably substantially due to large variations in electron temperature in the auroral E region. The available information on ion drifts is not adequate to determine whether the observed spectral peaks with Doppler velocities as great as 1800 m/s could have resulted from scattering from plasma waves in regions of large ion drift and enhanced plasma temperature. It is possible that spectral content with very large Doppler velocities resulted from some other mechanism such as plasma turbulence. Author (TAB)

N70-18674*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVIDENCE FOR A CORONAL MAGNETIC BOTTLE AT 10 SOLAR RADII
Kenneth H. Schatten Oct. 1969 20 p refs Submitted for publication
(NASA-TM-X-63811; X-616-69-447) Avail: CFSTI CSCL 03B

The Faraday rotation of a radio source (Pioneer 6) occulted by the solar corona has been measured by other authors. During the course of these measurements, three large scale transient phenomena were observed. These events were preceded by subflares and class 1 flares. These transient events are interpreted as evidence for a coronal magnetic bottle at 10 solar radii. The velocity of propagation for the disturbance is sat at 200 km/sec; the dimension of the region, 10 solar radii; field strength at 10 solar radii, 0.02 Gauss; particle density, 20,000 /cu cm; Alfven speed, 320 km/sec. From the nature of the observations and the lack of related effects from similar flares on the interplanetary sector pattern observed at 1 AU, it is suggested that such coronal magnetic bottles expand to perhaps 10 to 30 solar radii and then contract to a few solar radii. Such a phenomena is evidence for an expansion of the corona with a subAlfvenic velocity. It is further suggested that such magnetic bottles may be important in the storage and diffusion of solar generated cosmic ray particles. Author

N70-18779*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
SOFT SOLAR X-RAY BURST CHARACTERISTICS
Jerry F. Drake (Ph.D. Thesis) Jan. 1970 178 p refs
(Contract NAS5-9076; Grant NGL-16-001-002; Contract Nonr-1509(06))
(NASA-CR-108102; Rept-70-1) Avail: CFSTI CSCL 03B

The burst component of the solar X-ray flux in the soft wavelength range observed from Explorer 33 and Explorer 35 from July 1966 to September 1968 were analyzed. In this period 4028 burst peaks were observed. The differential distributions of the temporal and intensity parameters of the bursts revealed no separation into more than one class of bursts. The most frequently observed value for rise time was 4 minutes and for decay time was 12 minutes. The distribution of the ratio of rise-to-decay time can be represented by an exponential with exponent -2.31 from a ratio of 0.3 to 2.7; the maximum in this distribution occurred at a ratio of 0.3 . The values of the total observed flux, divided by the background flux, at burst maximum, can be represented by a power law with exponent -2.62 for ratios between 1.5 and 32. The distribution of peak burst flux as a function of H alpha importance revealed a general trend for larger peak X-ray fluxes to occur with larger H alpha flare areas and with brighter H alpha flares. Author

N70-18783*# Stanford Univ., Calif. Dept. of Applied Mechanics.
NOTE ON MODELS OF THE PROPAGATION OF SOLAR FLARE PLASMA THROUGH INTERPLANETARY SPACE
J. Hirshberg and John R. Spreiter 1969 21 p refs
(Contract NAS2-5355; Grant NGR-05-020-330)
(NASA-CR-108138) Avail: CFSTI CSCL 03B

Theoretical treatments of the propagation of a solar flare disturbance in interplanetary space discuss a blast wave expanding from the sun as a center of symmetry. However, recent observations indicate that the solar flare piston often is not expanding in a spherically symmetric manner. Some possible causes of the lack of spherical symmetry, assuming the blast models are essentially correct are examined. It is found that failures of different basic assumptions underlying the blast model lead to distinctly different shapes for the propagating flare body. The shapes are sufficiently different so that observations should soon be available that will distinguish between the models. Author

N70-18890*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PREDICTED HIGH ENERGY BREAK IN THE ISOTROPIC GAMMA RAY SPECTRUM: A TEST OF COSMOLOGICAL ORIGIN
G. G. Fazio and F. W. Stecker Jan. 1970 10 p refs
(NASA-TM-X-63818; X-641-70-26) Avail: CFSTI CSCL 03B

The purpose of this paper is to point out a critical test of the cosmological pion-decay hypothesis for the origin of the isotropic gamma radiation above 1 MeV and to predict a high-energy break in this component. The test lies in the detection of a break in the gamma ray energy spectrum due to interactions of these gamma rays with the universal blackbody radiation at large redshifts. Author

N70-18909*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEARCH FOR MAGNETIC MONOPOLES IN THE MOON
Kenneth H. Schatten Dec. 1969 24 p refs Submitted for publication Revised
(NASA-TM-X-63812; X-616-69-449) Avail: CFSTI CSCL 03B

The effects of a possible magnetic charge of the moon upon the magnetic field in the lunar vicinity have been analyzed. Magnetic field observations obtained by the GSFC magnetometer aboard Explorer 35 have been studied to search for these effects. Using these observations it is possible to obtain a measure of the net difference between the number of northern and southern monopoles within the moon which are of opposite sign. The search has resulted in negative findings and places an approximate upper limit on the average difference in the number of monopoles within the moon at 1.6 x 10-7 cm-3 or 7 x 10-32 per nucleon. Author

N70-18915*# California Univ., La Jolla. Dept. of Physics.
THE SPATIAL DISTRIBUTION OF THE DIFFUSE COMPONENT OF COSMIC X-RAYS
Daniel Alan Schwartz (Ph.D. Thesis) Sep. 1969 149 p refs
(Contract NAS5-3177; Grant NGL-05-005-003)
(NASA-CR-108171) Avail: CFSTI CSCL 03B

Data from the OSO-3 X-ray detector are analyzed in five logarithmically spaced energy channels to study the spectrum and angular distribution of the diffuse component in cosmic X-rays. Background phototube noise, counts due to cosmic induced gamma

rays, and counts due to gamma rays associated with the beta decay of Na-24 are substracted from raw counting rates and all known galactic discrete sources are avoided. Results establish the existence of a diffuse, apparently isotropic component of extraterrestrial X-rays in the energy range 0.25 to 10 to the 5th power keV. The absence of anisotropy, to roughly 20 per cent limits, strongly suggests that these X-rays have extragalactic origin. Excess emission areas in the lowest channel of 0.012 + or - 0.004 photons (sq cm sec rad)-1 at 10 keV indicate sources at distances of the order of the Hubble radius as significant contributors to the diffuse component. G.G.

N70-18922*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANOMALOUS COMPONENT OF ATMOSPHERIC MUONS
Kaichi Maeda Jan. 1970 11 p refs Revised
(NASA-TM-X-63740; X-641-69-491) Avail: CFSTI CSCL 04A

An alternate interpretation of the recent underground muon data of Keuffel et al is presented. This new interpretation, which does not invoke an anomalous component of atmospheric muons produced by the so-called X-process, attempts to resolve discrepancies existing between the previous and the latest Utah results, as well as those with data from the underground experiments at Kolar. Author

N70-18935 Case Western Reserve Univ., Cleveland, Ohio.
HIGH ENERGY ALBEDO AND SOLAR NEUTRONS NEAR THE TOP OF THE ATMOSPHERE
Allen Dale Zych (Ph.D. Thesis) 1968 154 p
Avail: Univ. Microfilms: HC $7.20/ Microfilm $3.00 Order No. 69-9445

Measurements of high energy neutrons from 12-100 MeV near the top of the earth's atmosphere are reported here for two balloon flights from Palestine, Texas. A polyethylene radiator in the form of plates in a spark chamber is used to detect protons produced by the incident neutron flux. For the first flight on 22 July 1967 at 9 g/sq cm, the energy anf zenith angle dependence of the proton emission spectrum per unit volume of radiator due to albedo neutrons was determined. The proton spectrum has been interpreted as due to a highly amsotropic high energy neutron flux where the dominant interaction for the neutrons is with the carbon in the polyethylene A lower limit for the albedo neutron flux at 9g/sq cm above 20 MeV of 0.16 neutrons/sq cm sec was determined. For the second balloon flight on 28 July 1967 at 7 g/sq cm the detector was directed upward. The proton emission spectrum for the downward moving neutrons was very much the same as for the albedo neutrons. Dissert Abstr.

N70-18945*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ION PAIR PRODUCTION FUNCTION OF THE LOWER IONOSPHERE
A. C. Aiken Nov. 1969 30 p refs Submitted for publication
(NASA-TM-X-63816; X-615-69-490) Avail: CFSTI CSCL 04A

Recent additions to the ionization mechanisms responsible for the lower ionosphere are reviewed. The acknowledged sources are: (1) Ionization of NO by solar Lyman alpha, (2) X-rays 2-8A acting on all constituents, (3) Cosmic radiation. There remain uncertainties in the ion pair production function for nitric oxide and in the reaction of the D region to different 2-8A fluxes. For instance recently published NO airglow measurements of the nitric oxide distribution are inconsistent with X-ray enhancement effects. Other processes which must be given consideration include: (4) Ionization of O2 by solar radiation; (5) Ionization of NO2 by solar Lyman alpha; (6) Energetic Electron precipitation; (7) Fragmentation of water conglomerates by X-radiation. Their contribution to the total ion pair production function will be discussed. Experiments are suggested which should lead to a better understanding of the relative importance of the different ionization mechanisms. Author

N70-19026# Environmental Science Services Administration, Washington, D.C.
SOLAR GEOPHYSICAL DATA: SUDDEN COMMENCEMENTS AND SOLAR FLARE EFFECTS APRIL-JUNE 1968
Nov. 1968 163 p
(ESSA-IER-FB-291) Avail: CFSTI

Sudden commencements and solar flare effects for May, September, and October 1948 are depicted graphically and by measured indices from international ground station observations as well as from geophysical satellite data. Observed were sunspot cycles, solar flares, calcium plages, and magnetic storms. G.G.

N70-19271*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ROTATING MOTION AND PRE-FLARE ACTIVITY OF THE SUNSPOT GROUPS ASSOCIATED WITH THE SOLAR PROTON FLARE ON 7 JULY 1966
Kunitomo Sakurai Jan. 1970 11 p refs Submitted for publication
(NASA-TM-X-63827; X-615-70-33) Avail: CFSTI CSCL 03B

The rotating motion of the sunspot group McMath No. 8362 is examined by using the observational data. This motion is counterclockwise so that the preceeding and following parts of the sunspot group gradually move northward and southward, respectively, during the growth of the sunspot group. When the sunspot group developed into a delta-type, the proton flare of 7 July 1966 was produced within this sunspot group. The activity of sub-flares before this occurrence suggests that the energy release from the sunspot group is inhibited by some mechanism which allows the accumulation of flare energy. Author

N70-19296 Alaska Univ., College.
POLAR AURORAL AND MAGNETIC SUBSTORMS: THEIR MORPHOLOGY AND RELATION TO THE RING CURRENT
Ching-I Meng (Ph.D. Thesis) 1968 321 p
Avail: Univ. Microfilms: HC $14.65/Microfilm $4.15 Order No. 69-8022

Magnetic storms in low latitudes, polar substorms, the relation between polar substorms and the growth of the ring current, and the polar cap aurora during magnetic storm sudden commencement are considered. It is shown that the polar electrojet which causes polar magnetic substorms in high latitudes usually flows westward in all longitudes along a closed oval curve (the auroral oval). From the study of the polar substorm conjugacy, it is found that the magnitude of positive bays is mainly controlled by the ionization produced by solar radiation and not by the intense auroral particle bombardment which is the major phenomenon during negative bays. Based on the morphology of polar substorms and the development of the ring current, models and mechanisms related to the energy transfer into the magnetosphere and the development of the polar substorm are discussed. The interchange instability of the ring current is a favorable mechanism for producing the polar substorm. Dissert. Abstr.

N70-19330# Environmental Science Services Administration, Washington, D.C.
SOLAR GEOPHYSICAL DATA: SOLAR RADIO SPECTRAL OBSERVATIONS, WEISSENAU SEPTEMBER 1968
Dec. 1968 149 p
(ESSA-IER-FB-292) Avail: CFSTI

Solar geophysical data presented cover the months June, October, and November 1968. Depicted graphically and by measured indices from international ground stations as well as from geophysical satellite observations are sunspot cycles, solar flares, calcium plages, and magnetic storms. G.G.

N70-19401# Institute of Nuclear Research, Warsaw (Poland).
ESTIMATION OF THE UPPER LIMIT OF THE ANISOTROPY OF MUON-POOR SHOWERS
Jerzy Jatczak 1969 21 p refs
(INR-1065) Avail: CFSTI

The distribution of the intensity of muon-poor showers is calculated as a function of sidereal time. Direct Fourier analysis does not make it possible to establish whether or not the intensity of such showers depends on the value of the right ascension. On the basis of statistical analysis and Monte Carlo calculations it is estimated that the upper limit of the anisotropy does not exceed 5%. Author (NSA)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N70-18344*# National Aeronautics and Space Administration, Washington, D.C.
SUMMARY OF RESULTS
In its Mariner-Mars 1969 p 5–12 (See N70-18343 07-31)
Avail: CFSTI CSCL 03B

Scientific experiments on Mariners 6 and 7 provided data for (1) the ratio of the mass of the Earth to that of the Moon and the radius of Mars as determined by S-band occultation; (2) the composition of the Martian atmosphere consisting of CO2 as the major constituent with broad absorptions due to solid H2O or surface hydrates, and the presence of solid CO2 at the polar cap; and (3) the heavily cratered surface of Mars and its similarity with the Moon surface. Nothing in the data encourages the belief that life exists on Mars. G.G.

N70-18352*# National Aeronautics and Space Administration, Washington, D.C.
S-BAND OCCULTATION
A. Kliore, G. Fjeldbo, B. Seidel, and S. I. Rasool *In its* Mariner-Mars 1969 p 111–126 refs (See N70-18343 07-31)
Avail: CFSTI CSCL 03C

In reducing the data from S-band occultation experiments to obtain pressure and temperature profiles, the composition of the Mars atmosphere was assumed to be 90 percent CO2 and 10 percent Ar. Comparison of calculated temperature profiles with theoretical models indicated that: (1) atmospheric temperatures at the equator at midafternoon were significantly higher than predicted by radiative transfer alone; (2) temperature distributions in midafternoon near the south polar cap and in the subtropics in the early morning hours agreed closely with predicted values when atmospheric dynamics were considered; and (3) at 79 degrees N latitude, the observed temperature profile suggested that condensation of CO2 occurred at almost all atmospheric heights. Refractivity measurements in the upper atmosphere of Mars indicated that the main ionization layer was produced by solar extreme ultraviolet and that the upper and lower atmospheres were warmer now than they were in 1965. Temperature increases were attributed to seasonal changes, increased solar activity, and a 10-percent reduction in the distance to the sun. G.G.

N70-18353*# National Aeronautics and Space Administration, Washington, D.C.
CELESTIAL MECHANICS
J. D. Anderson, L. Efron, and S. K. Wong *In its* Mariner-Mars 1969 p 127–134 refs (See N70-18343 07-31)
Avail: CFSTI CSCL 03C

Discussed are the tracking data used to determine Earth/Moon mass ratio and the mass of Mars. The value of the near-Mars tracking data was degraded through spacecraft accelerations introduced by blowdown of gas bottles on the infrared spectrometer. In the case of Mariner 7, the data were further degraded by a spacecraft anomaly that occured several days before encounter. Comparison of Doppler data from Mariners 4 and 6 showed good agreement in Mars mass determination and yielded a value of 42828.32 plus or minus 0.13 cubic km/square second. G.G.

N70-18356*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDY OF ABUNDANCE ANALYSIS OF STARS IN THE SPECTRAL RANGE B5 THROUGH G2 Semiannual Progress Report, 1 Jun. – 30 Nov. 1969
Stephen E. Strom Jan. 1970 7 p ref
(Grant NGR-22-024-001)
(NASA-CR-107945; SAPR-5) Avail: CFSTI CSCL 03A

Research progress is reported in helium abundances, blue stragglers, and stars in a premain-sequence contraction phase. A brief review of the results, and questions raised by these investigations are included. Author

N70-18402*# Boeing Co., Seattle, Wash.
PARAMETRIC VISION SIMULATION STUDY, PART 2 Final Report
D. C. Cunningham, Jr., N. N. Hansen, R. H. Osness, and F. E. Baird 1969 57 p refs Revised
(Contract NAS9-7198)
(NASA-CR-92387; D2-114040-3) Avail: CFSTI CSCL 22C

An attempt to evaluate the effects of landing site redesignation on visibility during a manned landing on the moon and complete reduction of data from both the previous phase, the Trajectory Study, and this phase, the Redesignation Study is presented. Results indicate that the landing site look angle must be 12 deg (+ or - 4 deg) below the sun angle to be fairly visible to the astronaut during a lunar landing, and that excessively high redesignation angles must be used to achieve fair visibility if the landing site look angle is substantially less than 12 deg below the sun angle. All data show a remarkable degree of consistency with photographic data of the moon from Lunar Orbiter 5. Author

N70-18403*# Boeing Co., Seattle, Wash.
PARAMETRIC VISION SIMULATION STUDY, PART 1 Final Report
D. C. Cunningham, Jr., N. N. Hansen, R. H. Osness, and F. E. Baird 1969 110 p refs Revised
(Contract NAS9-7198)
(NASA-CR-92386; D2-114040-2) Avail: CFSTI CSCL 22C

The simulation performed on the Space Flight Simulator duplicated the visual conditions to be encountered during the manned landing on the lunar surface. The simulated landing occurred on the morning terminator during the final phases of the retrograde orbit descent under a range of initial flight path angles from 13 deg to 19 deg and sun angle from 7 deg to 30 deg. Typical visual conditions that might actually be encountered by the astronauts under these trajectories and sun angle relations during lunar descent are shown in a photo of the Lunar Pyrenees taken by Lunar Orbiter 5. Simulation results indicate that angles of about 7 deg from the local horizon produce reasonably good visibility, whereas sun angles above approximately 15 deg produce very poor visibility. The effect of flight path angle on visibility was minor although test subjects indicated some preference for the higher trajectory angle. The study was subjective in nature because of the need to form value judgements on terrain visibility. Author

N70-18428*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
NUMERICAL INTEGRATION ORBITS AND BROUWER AND MODIFIED BROUWER ORBITS
Hans G. Hertz Aut. 1969 96 p refs
(NASA-TM-X-63809; X-552-69-332) Avail: CFSTI CSCL 22C

An orbit constructed by means of Brouwer's theory (AJ 64.378.1959) was compared with a numerical integration orbit started with the same initial conditions and values for the coefficients of the earth's potential. Two sets of comparisons were made: one every 2 minutes for a 10-day arc, and one every 4 hours for a 60-day arc. The differences Brouwer-Integration were appreciable but could be greatly reduced by modifying the computation of the short period terms and by applying second order short period terms to Brouwer's expression for the semi-major axis as derived from Kozai's theory (AJ 67.446.1962). A further reduction was obtained by basing the mean motion of the mean anomaly on Kozai. The differences Modified Brouwer-Integration were represented as sums of polynomials of degree zero or one and Fourier series. These analyses resulted in further corrections to Brouwer. New comparisons after the application of these corrections which are empirical were made. Author

N70-18454* Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

INVESTIGATION OF THE EARTH'S GRAVITATIONAL EFFECTS ON THE MOTION OF NEAR EARTH SATELLITES

S. M. Yionoulis Jun. 1969 178 p refs Sponsored by NASA (Contract NOw-62-0604-C)

(NASA-CR-107937; AD-696061; TG-1069) Avail: CFSTI CSCL 22C

The accuracy with which the earth's gravitational field can be defined from an analysis of satellite data is strongly dependent upon the satellite constellation used. The constellation selected must satisfy several criteria. The objective of this study was to produce quantitative information on the effects of the geopotential harmonics on the motion of satellites for a large variety of orbits. These data can then be used to investigate satellite constellations that will yield useful geodetic information. Author (TAB)

N70-18462*# International Business Machines Corp., Cambridge, Mass. Center for Exploratory Studies.

CORRELATION OF GRAVIMETRIC AND SATELLITE GEODETIC DATA. Interim Progress Report, 11 Sep. 1967 – 29 Feb. 1968

Gerald Ouellette and Pasquale Sconzo 29 Feb. 1968 49 p refs (Contract NAS12-598)

(NASA-CR-86326; CES-D181; IPR-1) Avail: CFSTI CSCL 22C

A study was carried out to ascertain the prediction accuracy in the position of a satellite over a 12-hr period at orbital altitudes where the period is approximately 100 minutes. The effect of errors in the geopotential coefficients in position predictions were studied. A base orbit was selected and analyzed extensively. The results indicate that the position of a satellite in a nearly circular orbit, inclined 45 deg, with a period of about 100 minutes can be predicted to within + or - 10 meters over a 12-hr period if a correlated set of geopotential coefficients is used. A numerical integration program was utilized to determine the error growth in position prediction by comparing a perturbed orbit with a nominal reference orbit. Unusual or unanticipated results in the numerical procedure were investigated analytically to determine the theoretical reasons for the behavior. The secular growth of in-track error, is discussed. The accuracy of the various published coefficient models was investigated to provide a quantitative measure of comparison between various results obtained in coefficient determination. Author

N70-18470# RAND Corp., Santa Monica, Calif.

FORMATION OF PLANETARY SYSTEMS BY AGGREGATION: A COMPUTER SIMULATION

Stephen H. Dole Oct. 1969 46 p refs Submitted for publication (AD-696491; B-4226) Avail: CFSTI CSCL 3/2

Planetary systems that display the major regularities and irregularities of the solar system have been produced in a series of computer experiments employing a Monte Carlo technique. It is hypothesized that stars and planets form within cold, dark globules of dust and gas through aggregation of grains and inelastic collisions of particles. A computer program simulates the processes by which planets grow in accordance with this hypothesis from preplanetary nuclei on random orbits within the cloud of dust and gas surrounding a newly formed star. Each planetary system generated by using a different series of random numbers inputs is unique, but in all cases the orbital spacings have patterns of regularity suggestive of Bodes law, and the planetary mass distributions are similar to the solar systems. Binary star systems are produced in the same program by increasing the value of one parameter, the coefficient of density in the cloud. Author (TAB)

N70-18481# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

THE EVOLUTION OF RESTRICTED PLANETOCENTRIC ORBITS OF SMALL BODIES DUE TO THE EFFECT OF DIRECT LIGHT PRESSURE [EVOLUTION DES ORBITES BASSES DE PETITS CORPS SOUS L' EFFET DE LA PRESSION DE RADIATION DIRECTE]

Yu. A. Chernikov [1969] 32 p refs In FRENCH and RUSSIAN (LRBA-69-1193) Avail: CFSTI

Within certain limits a closed solution was obtained and investigated for a system of equations, averaged by the Krylov-Bogolyubov method, for perturbed motion. It is shown that the longitudes of the ascending node and of the pericenter of all orbits have a secular variation, while the eccentricity and inclination undergo long-period perturbations. Transl. by R.B.

N70-18507# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

SOME PRINCIPLES FOR CONTROLLING THE ORBIT OF A SPACECRAFT [SUR CERTAINES LOIS DU PILOTAGE D'UN ENGIN SPATIAL EN ORBIT]

D. A. Mamatkazin [1969] 11 p refs Transl. into FRENCH from Russian publication In FRENCH and RUSSIAN (LRBA-69-0457) Avail: CFSTI

Problems are considered for the motion of a spacecraft under the influence of controlling acceleration in a plane perpendicular to the absolute speed vector of its center of gravity. Principles for controlling the craft are proposed which permit the solution to be obtained in analytical form. Transl. by R.B.

N70-18561# Texas Univ., Austin. Applied Mechanics Research Lab.

APPLICATION OF VON ZEIPEL'S METHOD TO MOTION ABOUT THE EARTH-MOON TRIANGULAR LIBRATION POINTS INCLUDING THE INFLUENCE OF THE SUN

Bob E. Schutz Jun. 1969 152 p refs (Contract N00014-67-A-0126-0007)

(AD-696593; TR-1005) CSCL 3/3

The solar influenced motion of a particle near the earth-moon triangular libration points was studied. The von Zeipel method was applied to the very restricted problem of four bodies proposed by Huang. Although this model of the restricted problem of four bodies excludes the indirect effect of the sun, it exhibits some of the features observed in more realistic models. Author (TAB)

N70-18644*# Stanford Univ., Calif.

RESEARCHES IN OPTIMAL RENDEZVOUS

Walter Heine Washington NASA Feb. 1970 62 p refs (Grant NGR-05-020-007)

(NASA-CR-1508; SUDAAR-382) Avail: CFSTI CSCL 22C

The time-fixed transfer between two elliptic orbits is optimized. The transfer is to be accomplished with minimum fuel requirements. Impulsive thrusts are assumed. The objective of the problem is to determine the number and nature of the impulses required for

various orbit geometries. Two special cases are investigated which result from assuming symmetric impulse magnitude and locations. The first case has symmetry about the line of nodes and the second has symmetry about a line perpendicular to the line of nodes. The assumption of symmetry of the impulses requires that the orbits, assumed to be nearly circular, have equal semi-major axes. The application of symmetric impulses causes the vacant focus to be displaced perpendicular to the line of symmetry. The maximum number of impulses in the first case is six, whereas in the second the maximum number is four. Charts are presented, for both cases of the time-fixed transfer problem, which show the definition of one, two, three, four, five, and six impulse regions in parameter space. Author

N70-18653# Joint Publications Research Service, Washington, D.C.
SPACECRAFT ADVANCES FIND APPLICATION ON EARTH
B. Adamovich 13 Jan. 1970 6 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 16 Oct. 1969 p 2
(JPRS-49592) Avail: CFSTI

Applications of space biology and medical technology in other fields are cited. These include cultivation of controlled biosynthesis in lower aquatic plants and extraction of protein from these plants which could aid in the problem of protein starvation; mathematical calculations of the mechanisms regulating vital functions aimed at predictions of behavior under given conditions; portable sources of electrical power for mining and geological exploration; oxygen regeneration systems based on complete decomposition of carbohydrates in plasma or a discharge of electricity; and industrial application of highly active catalysts, filters, and technical processes that are used in physical and chemical spacecraft lift support systems. Application of satellite weather forecasting data will also facilitate in developing greenhouse operations for efficient cultivation of superior plants. Author

N70-18655*# Massachusetts Univ., Amherst. Physics and Astronomy Dept.
VARIATIONS IN THE COLOR OF JUPITER DURING 1963 - 65
Neil B. Hopkins and William M. Irvine [1967] 13 p refs
(Grant NGL-22-010-023)
(NASA-CR-108097) Avail: CFSTI CSCL 03B

Observations of Jupiter by multicolor photoelectric photometry in 10 narrow bands between 3150 A and 0.06 microns and in UBV showed a brightening for shorter wavelengths in 1965 relative to 1963. An opposite effect occurred for the band at 7300 A. These results are consistent with observed activity in the Jovian atmosphere. No obvious correlation could be found between brightness fluctuations and longitude of the central meridian, indicating that the activity was uniform in longitude or occurred on time scales short compared to a month. Author

N70-18658*# Massachusetts Univ., Amherst. Physics and Astronomy Dept.
LONGITUDINAL VARIATIONS, THE OPPOSITION EFFECT AND MONOCHROMATIC ALBEDOS FOR MARS
William M. Irvine, James C.Higdon, and Susan J. Ehrlich (Smith College) [1969] 32 p refs Prepared in cooperation with Smith Coll.
(Grant NGL-22-010-023)
(NASA-CR-108096) Avail: CFSTI CSCL 03B

Observations of Mars previously reported in 10 narrow bands between 3150 A and 1.60 micron and in UBV are analyzed for brightness variations which correlate with longitude of the central meridian. Such an effect is found for wavelength > or ~ 5000 A, with some evidence for such a correlation at wavelength ~ 4570 A.The data are then corrected to the mean (over longitude) brightness and a linear phase curve fitted to those observations with phase angle i > 15 deg. An opposition effect (anomalous brightning at small phase angles) is found for wavelenghts < or ~ to 5500 A, in contrast to a result previously reported. The magnitude at zero phase, phase coefficient, and monochromatic albedo are computed for Mars as a function of wavelength. Author

N70-18676*# Hawaii Univ., Honolulu.
A PHOTOELECTRIC STUDY OF THE NIGHTGLOW Final Report, 1 Jun. 1964-31 Oct. 1968
J. L. Weinberg Nov. 1968 98 p refs
(Grant NGR-12-001-004)
(NASA-CR-108086) Avail: CFSTI CSCL 03B

A modified airglow telescope and a synchronous detection system were used to measure Stokes parameters of nightglow, and from this to determine zodiacal light characteristics. The one-color photometric system utilized a coupled rotating polaroid-synchronous detector to measure, with Fabry optics, the brightness of the total and of the polarized component of the nightglow, and the orientation of the plane of polarization. Facility design and instrumentation, special purpose and monitoring programs, observing conditions, data reduction and calibration, and results of observing and interpretive programs are described. J.A.M.

N70-18744*# Bellcomm, Inc., Washington, D.C.
LUNAR IGNEOUS INTRUSIONS
Farouk El-Baz 3 Dec. 1969 9 p refs
(Contract NASw-417)
(NASA-CR-108099; TR-69-340-5) Avail: CFSTI CSCL 03B

Apollo 10 and 11 photographs reveal a number of probable igneous intrusions, including three porbable dikes that crosscut the wall and floor of an unnamed 75 km crater on the moon's farside. These intrusions are distinguished by their setting, textures, structures, and brightness relative to the surrounding materials. Recognition of these probable igneous intrusions in the lunar highlands augments the many indications of the heterogeneity of lunar materials and the plausibility of intrusive igneous activity, in addition to extrusive volcanism, on the moon. Author

N70-18754*# Northrop Corp., Huntsville, Ala.
LAUNCH VEHICLE TRAJECTORY OPTIMIZATION COMPUTER PROGRAM, PHASE 4 Summary Report
C. B. Hose, Jr., T. D. Neeley, and D. R. Kilpatrick 12 Aug. 1969 15 p
(Contract NAS8-30509)
(NASA-CR-102456; TR-796-9-597) Avail: CFSTI CSCL 22C

The need for quick response by mission planners and the large amounts of optimum performance data that have been generated for a number of launch vehicles of interest has resulted in the NASA request for a quick retrieval system for surveying optimum performance variations due to mission and vehicle variations. Described in this summary technical report is the Automatic Performance Trade-off (APT) computer program which is response to the NASA need. To satisfy the needs of mission planners such a system should have the following characteristics. First, it should efficiently catalog and store information from optimum launch vehicle trajectories in large data banks. Secondly, it should be able to quickly retrieve these data and by using numerical techniques expand its range of usefulness. Finally, it should display these data in several formats each of which have been designed to maximize the immediate usefulness of the data to a particular mission planning function. The Automatic Performance Trade-off program completely satisfies these requirements. Author

N70-18763*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CONTRIBUTION OF ATMOSPHERIC AEROSOLS TO THE MARTIAN OPPOSITION EFFECT
Jaylee M. Mead Jan. 1970 39 p refs Submitted for publication
(NASA-TM-X-63815; X-641-70-13) Avail: CFSTI CSCL 03B

The Mie theory is used to compute the integrated scattering intensities for submicron aerosol particles with various indices of

refraction and several size distributions in an effort to determine if the presence of atmospheric aerosols can account for the Martian opposition effect. This non-linear surge is brightness, as the planet approaches a phase angle of 0 deg, is reported to be much more pronounced in the ultraviolet than in the infrared. The calculations show that neither substances having a refractive index n between 1.20 and 1.50, which include ice, water, and solid CO2, nor highly absorbing materials, such as limonite, can produce the opposition effect. By introducing an assumed surface function, which is added to the contribution by aerosols with $n = 1.75$, a model is obtained which compares reasonably well with the observations. A similar fit was obtained for $n = 1.55$ and could probably be obtained for any real index between 1.55 and 1.75. This range includes most semi-transparent minerals, thus making them good candidate for producing the opposition effect. Author

N70-18788*# Northrop Corp., Huntsville, Ala.
LAUNCH VEHICLE TRAJECTORY OPTIMIZATION COMPUTER PROGRAM, PHASE 4 Final Technical Report
C. B. Hose, Jr., T. D. Neeley, and D. R. Kilpatrick 12 Aug. 1969 102 p refs
(Contract NAS8-30509)
(NASA-CR-102457; TR-796-9-594) Avail: CFSTI CSCL 22C

A computer program is described which retrieves stored data and determines variations in launch vehicle performance as a function of mission and vehicle parameters. The data stored by the program were generated by sophisticated launch vehicle optimization programs. This program was developed as a tool for mission planning permitting an instant response capability for preliminary problem analysis. Cataloging techniques developed for various missions are described. These techniques determine the points which must be stored for a particular mission. Large quantities of data for various launch vehicles were stored in the program and by using interpolation and extrapolation techniques new data may be generated from this stored information. Author

N70-18802 Case Western Reserve Univ., Cleveland, Ohio.
THE INTERSTELLAR REDDENING LAW IN THE DIRECTION OF CEP OB3
Russell Kent Honeycutt (Ph.D. Thesis) 1968 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 69-9409

The interstellar reddening law between 3360 A and 8400 A was derived for the members of the association Cep OB3 and for an adjacent comparison region. The method employed was photographic spectrophotometry of objective prism spectral images, with plate calibration provided by an objective grating. No differences were found between the reddening curve for Cep OB3 and the comparison region. The mean normalized reddening curve resembles Nandy's curves for nearby regions in displaying two nearly linear portions either side of 4300 A. When the extinction in magnitudes is plotted as a function of inverse wavelength the ratio of the slope in the ultraviolet to the slope in the visual was found to be 0.62. Dissert. Abstr.

N70-18852*# New Mexico State Univ., Las Cruces. The Observatory.
JUPITER'S RED SPOT IN 1968-1969
E. J. Reese Oct. 1969 16 p refs
(Grants NGL-32-003-001; NGR-32-003-027)
(NASA-CR-108143) Avail: CFSTI CSCL 03A

Photographic observations of Jupiter's Red Spot between 14 October 1968 and 24 August 1969 are reported. The Red Spot regained all of the darkness and area that it had exhibited from 1961 to early 1966. A 3-month oscillation in longitude was observed for the sixth consecutive apparition. A series of dark streaks apparently were emitted from the preceding tip of the Red Spot, and advanced from that feature at the rate of 17 m/sec. Two dark spots on the north edge of the South Temperate Belt encountered the Red Spot and underwent accelerations which were an order of magnitude greater than the greatest acceleration previously observed in the atmosphere of Jupiter. Author

N70-18865*# Bellcomm, Inc., Washington, D.C.
EVALUATION OF MOBILITY MODES ON LUNAR S EXPLORATION TRAVERSES: MARIUS HILL, COPERNICUS PEAKS, AND HADLEY APENNINES MISSIONS
P. Benjamin, T. A. Bottomley, J. W. Head, and M. T. Yates 14 Nov 1969 65 p refs
(Contract NASw-417)
(NASA-CR-108134; TR-69-340-4) Avail: CFSTI CSCL 22A

A comparative analysis is made of the influence of riding or walking traverses on the capability for meeting lunar science objectives on J-type missions. In addition to making trade-offs between distance traveled and number of sites visited to maximize scientific return, the analysis evaluated the effect of a LM landing at locations other than the preferred point in Marius Hills. Energy and time costs were estimated consistent with the work capabilities of the A7L suit and uprated life support systems. Riding missions, on the average and exclusing ALSEP contribution, approximately double the amount of significant scientific activity achievable over walking missions. At Marius Hills, the rover enables a significant amount of scientific information to be recovered which would be unachievable on walking missions if a biased target were substituted for a science mission target. Author

N70-18886 Cornell Univ., Ithaca, N.Y.
OBSERVATIONS OF INTERSTELLAR MOLECULAR HYDROGEN
Michael Wolock Werner (Ph.D. Thesis) 1968 203 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-8886

An observational program for the detection of interstellar molecular hydrogen was conceived and carried out. The observational technique involves a search for vibration-rotation emission lines from the ground electronic state of H2. These lines are produced in a resonance fluorescence process initiated by an electronic absorption in the ultraviolet bands of H2, followed by deexcitation into an excited vibrational level of the ground electronic state and a cascade into the ground vibrational level. A detailed theory of this radiative cascade process was developed. Two lines in the (3-0) band of H2, the O(2) line at 8748 A, and the Q(3) line at 8560 A, were sought. The apparatus used was a pressure-scanned Fabry-Perot interferometer. Observations were made at the Kitt Peak National Observatory. Dissert. Abstr.

N70-18901*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LUNAR SURFACE MODELS NASA Space Vehicle Design Criteria (Environment)
May 1969 60 p refs
(NASA-SP-8023) Avail: CFSTI CSCL 03B

Engineering models of the lunar surface are needed in mission planning and in the design of landing and exploration vehicles and lunar bases. Models of terrain and soil mechanical properties assist in the evaluation of vehicle landing performance, descent engine plume-surface interactions, and exploration vehicle performance and power requirements. Crater and block (rock) models aid in assessing hazardous landing conditions and obstacles encountered in typical traverse missions. Optical models help in establishing camera design parameters and in determining visual capabilities of astronauts. Dielectric models aid in radar system design. Chemical, bearing strength, density, and thermal models are used in design of surface and subsurface base structures and surface vehicles. The lunar surface models presented in this monograph are based on 1968 state of the art; they upgrade and extend the earlier engineering models and the criteria guidelines previously published. They are founded on a review and interpretation of available literature and

lunar data as well as discussions with scientists familiar with data provided by the Ranger, Surveyor, and Orbiter programs, and the Russian Luna probes. In addition, these engineering models reflect, where possible, the consensus of the NASA Lunar Trafficability Model Working Group, composed of members of NASA centers and other government agencies working on lunar exploration programs.
Author

N70-18919*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
PLANETARY ENVIRONMENT SIMULATION: MARTIAN SAND AND DUST STORM SIMULATION AND EVALUATION, VOLUME 2
G. L. Adlon, R. K. Weinberger, and D. R. Mc Clure 31 Oct. 1969 66 p refs
(Contract NAS1-8708)
(NASA-CR-66882; MDC-E0038-Vol-2) Avail: CFSTI CSCL 03B

Experiments were performed on 297 to 420 micron particles to determine the forces acting on those particles when subjected to an air flow that simulated hypothetical Martian surface pressure and wind velocity. Studies with particles entrained in a free-stream flow and on particles lying on a flat plate showed that drag and lift effects depended on the velocity lag of the particle with respect to gas velocity. The degree of particle roughness or irregularity effected the flow field around particle body through rotation and orientation in the flow, particle wake, relative fluid turbulence and thus initiated vortex rings. Negative flow occurred depending on the type of gas flow and the degree of asymmetry in the wake structure. Analysis of particle entrainment from a flat plate at free-stream velocities near 230 ft/sec showed three basic types of responses: (1) no movement; (2) movement along the surface in straight lines parallel to flow direction; and (3) particle entrainment. The latter response was preceded by a roll or a collision and did not take place through the action of the gas flow alone. G.G.

N70-18953*# Geological Survey, Washington, D.C. Branch of Astrogeologic Studies.
ASTROGEOLOGIC STUDIES Annual Progress Report, 1 Oct. 1968–30 Sep. 1969
Jan. 1970 93 p refs
NASA Order T-66353-G; NASA Order T-75415; NASA Order R-66; NASA Order W-11775; NASA Order W-12872 et al
(NASA-CR-108135) Avail: Issuing Activity CSCL 03B

The activities of investigating and mapping the geology of the moon and planets are reported. The programs of lunar geologic mapping, lunar physics, and lunar engineering geology are described, and the progress in field and laboratory studies of craters and related phenomena are presented, including impact structures, shock phases, and manmade craters. An analysis of the chemistry and petrology of Apollo 11 samples from Tranquility Base is being performed for geochemical evaluation, and for impact effects. A summary of the chemistry of the Surveyor landing sites, and an assessment of geologic studies in support of Mars missions are included.
F.O.S.

N70-18965# Joint Publications Research Service, Washington, D.C.
GREAT RADIOBURSTS OF THE SUN
N. P. Tsimakhovich 14 Jan. 1970 139 p refs Transl. into ENGLISH from the book "Bolshiye Radiovspleski Solntsa" Riga, Zinatne Publishing Office, 1968 p 4-67 Submitted for publication
(JPRS-49611) Avail: CFSTI

The general problems involved in the solar radio service and correlation of results from different observatories are discussed. Longitudinal asymmetry, which is the higher level of solar radio flux measured at observatories on the western coast of the Pacific Ocean, is described. An intermediate four-frequency classification of radio bursts is introduced for determining the spectral type of bursts from monochromatic observations. The spectral properties of geoeffective radio bursts are analyzed on the basis of their four-frequency characteristics and the possibility of determining the chemical composition of solar cosmic rays using the four-frequency spectrum is investigated. Large solar radio bursts are discussed on the basis of monochromatic records obtained from data of the world network.
Author

N70-18984*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THE SOLID OF MODEL UNIVERSES
Windsor L. Sherman Washington Feb. 1970 49 p refs
(NASA-TN-D-5712; L-6212) Avail: CFSTI CSCL 03A

A modified form of the red-shift – magnitude relation is used to develop a solid called the solid of model universes. The solid of model universes relates the nonlinear part of the apparent manitude to the density parameter, acceleration parameter, the red shift, and the time since the beginning of expansion. The solid of model universes offers an improvement over the tabular method of presenting Robertson's models of the universe and permits the rapid comparison of simplified models with the exact model and the comparison of models determined from observation by various methods. The determination of the nonlinear part of the apparent magnitude will permit the use of the solid of model universes to estimate the density and acceleration parameter. The numerical data necessary for constructing the solid of model universes are presented.
Author

N70-19007*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
STATISTICAL ANALYSIS OF METEOROID PENETRATION DATA INCLUDING EFFECTS OF CUTOFF
J. M. Alvarez Washington Feb. 1970 72 p refs
(NASA-TN-D-5668; L-5944) Avail: CFSTI CSCL 03A

The meteoroid data from Explorers 13, 16, and 23 are treated from two standpoints: statistical analysis of the penetration data per se and an interpretation of the meteoroid environment from the penetration data. Expressions describing the data as a function of time are obtained and used to calculate penetration rates through various kinds of detectors. No shower activity was noted in the data. An error analysis indicated that a constant penetration rate can be adequately defined from the first eight or 10 penetrations. The existence of a lower limit (a cutoff) on the size of meteoroids is investigated to see how such a limit affects penetration data. A meteoroid flux varying as a(-alpha), where a is the meteoroid radius and alpha is a constant, was fit to the Explorer and Pegasus data to test the strength of cutoff effects. These effects were found capable of explaining the apparently different values of alpha obtained by the Explorer and Pegasus penetration experiments.
Author

N70-19025# Congress. House. Committee on Science and Astronautics.
ASSESSMENT OF SPACE COMMUNICATIONS TECHNOLOGY: HEARINGS
Washington GPO 1970 251 p refs Hearings before Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., No. 12, 16-19 Dec. 1969
Avail: Subcomm on Space Sci. and Appl.

The subcommittee reviews the work of NASA in the development of space communications systems in order to assess the current state-of-the-art of communications satellites technology and to examine trends and directions in this activity. Particular emphasis is placed on technology utilization for domestic communications via satellite and an apparent development lack in this direction.
G.G.

N70-19105# Chile Univ., Santiago.
SPECTROPHOTOMETRIC PARAMETERS OF EARLY-TYPE STARS. PART 2: RELATIVE SPECTRAL-INTENSITY DISTRIBUTIONS

A. Gutierraz-Moreno, H. Moreno, and J. Stock [1969] 38 p refs *Its* Publ. No. 8
Avail: CFSTI

Spectral-intensity distributions, relative to zeta Puppis, are given for 172 stars. The data permitted the determination of the size and position of the Balmer discontinuity, the emission in the Balmer continuum for "ce" stars, and the gradient of the continuum in the ultraviolet and blue-green-yellow part of the spectrum. For some stars, the relative magnitude curve shows an ultraviolet deficiency, which was also measured considering its possible physical significance. Author

N70-19128*# Geological Survey, Washington, D.C.
GEOLOGIC TRANSCRIPT FROM APOLLO 11 MISSION
David Schleicher, ed. Dec. 1969 70 p ref *Its* Astrogeol. 20
(NASA Order-65253-G)
(NASA-CR-108200) Avail: CFSTI CSCL 22A

A quick-time transcript was prepared by two court reporters working together. The first reporter transcribed the discussion on a stenograph (shorthand) typewriter, and the second translated the stenograph notes and typed the transcript. The transcript was displayed on closed-circuit television in MCC-H, generally within a minute after the corresponding voice communication. Isolated short phrases commonly appeared within seconds. Xerox copies of the transcript were distributed within a few minutes after it was typed. The total quick-time transcript comprises almost 11,000 words and covers 11 hours and 22 minutes, from GET 04 04 17 to GET 04 15 39. The part from the 2.5-hour EVA comprises roughly 4,500 words, about half of which related to the Lunar Geology Experiment. The reporters, particularly the typist, took occasional rest periods when they deliberately omitted nongeologic discussion. Occasional brief transmissions are thus excluded, but Astronauts Armstrong's and Aldrin's comments from descent, touchdown, and EVA are essentially complete. Author

N70-19140*# National Aeronautics and Space Administration, Washington, D.C.
SPACE RESOURCES FOR TEACHERS. SPACE SCIENCE: A GUIDE OUTLINING UNDERSTANDINGS, FUNDAMENTAL CONCEPTS, AND ACTIVITIES
1969 145 p refs
(NASA-EP-64) Avail: CFSTI CSCL 05I

An interdisciplinary study of space science is presented for use in secondary schools or the first two years of college. A topical outline of the material, sample questions and problems, suggested audiovisual aids, and annotated bibliographies are given. The discussion is divided into the following units of study: measurement, distance, and size in astronomy; atoms, spectra, and stars; atomic nuclei and stars; the solar system; the origin and evolution of life; and motion, rockets, and gravity. N.E.N.

N70-19188# Lockheed Missiles and Space Co., Palo Alto, Calif.
NEW EXPLANATIONS OF MAYEDA'S FLARE ON MARS, PART 2
V. D. Davydov 1969 17 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 46, no. 5, 1969 p 1074-1086
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A solar glint hypothesis was formulated in two versions to explain the nature of the white point: five minute flare on the limb of Mars observed in Japan by S. Mayeda on 4 June 1937. In accordance with this hypothesis, Mayeda saw a direct reflection of sun rays from either a Martian cloud of ice crystals giving a parhelic halo, or an object located on the hard Mars surface and possessing a vertical reflecting surface. A quantitative treatment and comparison between both versions are given, and other cases of the appearance of a temporary white point on Mars are discussed. Author

N70-19288# Lockheed Missiles and Space Co., Palo Alto, Calif.
MARS ATMOSPHERE FROM POLARIZED OBSERVATIONS
A. V. Morozhenko 1969 9 p refs Transl. into ENGLISH from Astron. Zh. (Russian), v. 46, no. 5, 1969 p 1087-1094
Avail: CFSTI

Optical parameters of the Martian atmosphere were determined from polarized observations, taking into account light scattering by uniform spherical particles with a refractive index of 1.5 and a Yunge particle size distribution. The results indicated that: (1) The mean angle of inversion of surface polarization is 28%. (2) The Rayleigh component of atmospheric optical thickness is 0.016 for 355 millimicrons, and the thickness of the aerosol component is 0.048 at the same wavelength. (3) The Yunge distribution parameter is about 4.25. (4t Atmospheric pressure on the surface is approximately 11 millibars. A.C.R.

N70-19462# Geological Survey, Flagstaff, Ariz. Branch of Astrogeologic Studies.
REVISED POWER SPECTRAL DENSITY FUNCTIONS DESCRIBING MAJOR LUNAR TERRAIN TYPES
Richard J. Pike 11 Feb. 1970 18 p refs
Avail: Issuing Activity

Power spectral density (PSD) functions are presented as descriptors of lunar topographic character, and are considered relevant to the design of lunar roving vehicles. The individual Pike curves were supplanted by pairs of curves delimiting maximum and minimum PSD for each of the terrain types: smooth, rough mare, hummocky, and rough upland. The data for lunar locality is presented in tables and charts. F.O.S.

N70-19583*# Chicago Univ., Ill. Enrico Fermi Inst. for Nuclear Studies.
ALPHA RADIOACTIVITY OF THE LUNAR SURFACE AT THE SURVEYOR 5, 6, AND 7 LANDING SITES
Anthony L. Turkevich, James H. Patterson (Argonne Natl. Lab., Ill.), Ernest J. Franzgrote (JPL, Calif. Inst. of Tech.), Kenneth P. Sowinski, and Thanasis E. Economou 2 Jan. 1970 13 p refs Submitted for publication Sponsored in part by NASA
(NASA-CR-108229; EFI-70-1) Avail: CFSTI CSCL 03B

Evidence has been obtained for a radioactive deposit on the lunar surface at Mare Tranquillitatis with a total intensity of 0.09 + or - 0.03 alpha disintegration/sec/sq cm. The presence of Po210 in close-to-equilibrium amounts indicates a continuous turnover rate of lunar material at this site of less than 0.1 micron per year. The lack of such a deposit at two other lunar sites suggests lower local concentrations of uranium there. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N70-18343*# National Aeronautics and Space Administration, Washington, D.C.
MARINER-MARS 1969 A Preliminary Report
1969 148 p refs
(NASA-SP-225) Avail: CFSTI CSCL 22B

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1. SUMMARY OF RESULTS p 5-12 (See N70-18344 07-30)
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5. TELEVISION OBSERVATIONS FROM MARINERS 6 AND 7 R. B. Leighton, N. H. Horowitz, B. C. Murray, R. P. Sharp, A. G. Herriman et al p 37-82 refs (See N70-18348 07-31)

6. INFRARED SPECTROSCOPY K. C. Herr and G. C. Pimentel p 83-96 refs (See N70-18349 07-14)

7. ULTRAVIOLET SPECTROSCOPY C. A. Barth, W. G. Fastie, C. W. Hord, J. B. Pearce, K. K. Kelly et al p 97-104 (See N70-18350 07-14)

8. INFRARED RADIOMETRY G. Neugebauer, G. Muench, S. C. Chase, Jr., H. Hatzenbeler, E. Miner et al p 105-109 refs (See N70-18351 07-14)

9. S-BAND OCCULTATION A. Kliore, G. Fjeldbo, B. Seidel, and S. I. Rasool p 111-126 refs (See N70-18352 07-30)

10. CELESTIAL MECHANICS J. D. Anderson, L. Efron, and S. K. Wong p 127-134 refs (See N70-18353 07-30)

N70-18345*# National Aeronautics and Space Administration, Washington, D.C.

THE PROGRAM AND ITS SPACECRAFT

In its Mariner-Mars 1969 p 13-19 (See N70-18343 07-31)

Avail: CFSTI CSCL 22B

The objective of the Mariner-Mars 1969 project was to conduct flyby missions for exploratory investigations of Mars and to develop the technology needed for succeeding Mars missions. Functional capability and instrument performance described cover the following scientific experiments: (1) Television; (2) infrared spectroscopy; (3) infrared radiometry; (4) ultraviolet spectroscopy; (5) S-band occultation; and (6) celestial mechanics. G.G.

N70-18346*# National Aeronautics and Space Administration, Washington, D.C.

THE FLIGHTS

In its Mariner-Mars 1969 p 21-26 (See N70-18343 07-31)

Avail: CFSTI CSCL 22B

Described are the separate launching, cruise, and encounter of Mariners 6 and 7 and their photographic recordings of Mars. All pictures were recorded by the spacecrafts analog tape recorders and played back to ground based antennas for further analyses. Analyses of the Mariner 6 far-encounter pictures showed that additional pictures of the polar cap are desirable. The mariner 7 encounter within 3430 km of the Martian surface provided additional atmospheric data and valuable spectra in the 6 to 14 micron range; scientific operations during its cruise mode included star photography tests of the television cameras and ultraviolet spectrometer scans of the Milky Way and an area containing a comet. G.G.

N70-18347*# National Aeronautics and Space Administration, Washington, D.C.

SCIENTIFIC PAYLOAD

In its Mariner-Mars 1969 p 27-36 (See N70-18343 07-31)

Avail: CFSTI CSCL 22B

Different aiming points were selected for Mariners 6 and 7 missions to: (1) explore further the surface and atmosphere of Mars in an effort to determine whether or not life forms could exist in it; and (2) to develop the technology necessary to conduct experiments for succeeding missions to Mars. A payload of five selected scientific experiments yielded data on the physical, chemical, and thermal properties of the planet and the purpose of a sixth experiment was to define astronomical data. To enhance the results, trajectories of Mariners 6 and 7 were so selected as to provide four occultation points separated in latitude. G.G.

N70-18348*# National Aeronautics and Space Administration, Washington, D.C.

TELEVISION OBSERVATIONS FROM MARINERS 6 AND 7

R. B. Leighton, N. H. Horowitz, B. C. Murray, R. P. Sharp, A. G. Herriman et al *In its* Mariner-Mars 1969 p 37-82 refs (See N70-18343 07-31)

Avail: CFSTI CSCL 22B

A primary objective of the television experiment was to examine at close range the Martian surface. While confirming a cratered appearance similar to that of the Moon, preliminary analyses of television pictures from Mariners 6 and 7 indicate that: (1) the surface is clearly visible in all wavelength used; (2) thin, patchy aerosol scattering layers are present at several latitudes; (3) diurnal brightening in the W-cloud area is associated with topographic features; (4) darkening and localized bright patches are clearly visible near the polar cap; (5) widespread cratered terrain is predominant; (6) two populations of primary craters are clearly distinguishable; (7) areas of chaotic and featureless terrains are also present; (8) tectonic and topographic forms similar to Earth features are absent; (9) both atmospheric/surface and topographic effects are observed on the south polar cap; (10) variable atmospheric and atmosphere/surface effects are found at high northern latitudes; and (11) classical features of craters or crater remnants are identified. It is also pointed out that the observed scarcity of water is a serious limiting factor for life on Mars and that the observed dark regions on Mars show nothing favorable to assume that life is possible. G.G.

N70-18416# North American Rockwell Corp., Downey, Calif. Space Div.

APOLLO CSM DYNAMIC TEST PROGRAM

A. E. Chirby, R. A. Stevens, and W. R. Wood, Jr. *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 105-121 refs (See N70-18404 07-32)

Avail: CFSTI

Four vibro-acoustic tests were performed to determine the validity of the Block 2 CSM random vibration criteria. The calibration tests established the SAL acoustic environment which would produce Block 1 CSM random vibration levels. Calibration tests were accurate acoustic forcing functions for CSM 105/AV. The vibration tests also demonstrated the CSM structural integrity and measured the CSM vibratory response in the 4 to 30 Hz frequency range. Author

N70-18466*# National Aeronautics and Space Administration, John F. Kennedy Space Center, Cocoa Beach, Fla.

APOLLO 12 WATER SERVICING

A. P. Buck, V. E. Christiansen, P. La Torre, and E. Wright 19 Dec. 1969 56 p

(NASA-TM-X-64063; GP-804) Avail: CFSTI CSCL 22B

The complete documentation of the water servicing for Apollo 12 is presented. The scope of water servicing includes the verification of facility demineralized water, ground support equipment water units, lunar module, command module spacecraft, portable life support system, liquid cooling garment and sterilization of water dispensers. None of the analysis reports failed the specifications during the entire chamber tests except for the sterility requirements, which were expected due to the lack of a bactericide, and there were detectable increases of the ionic species for nickel, magnesium and zinc in the command module use ports. The sterilization of the water dispenser procedure was modified by increasing the iodine bactericide solution to 80-100 parts per million. A copy of all pertinent sample reports is included. F.O.S.

N70-18574*# Pan American World Airways, Inc., Patrick AFB, Fla. Aerospace Services Div.

OPERATIONAL EXPERIENCE WITH PASSIVE FALLING SPHERES ON THE AFETR

O. H. Daniel *In* NASA, Washington Status of Passive Inflatable Falling-Sphere Technol. for Atmospheric Sensing to 100 km 1969 p 65-68 Supported by AF (See N70-18570 07-01)

Avail: CFSTI CSCL 22B

Described is the development and experimental performance of the Arcas/Robin system for measuring meteorological parameters above the altitude limits of balloon rawinsonde systems. Atmospheric data acquired by inflatable falling sphere payloads of meteorological rockets produced required wind and density values to 295 000 feet for Apollo launch support. G.G.

N70-18690*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMOPHYSICS RESEARCH
Gerhard B. Heller *In its* Proc. of the Third Southeastern Seminar on Thermal Sci. 8 May 1968 p 143-191 (See N70-18686 07-33)
Avail: CFSTI CSCL 22B

Thermophysical research activities cover a wide area from basic research to applications in mainline space flight projects. The main factors considered are solar radiation, planetary albedo, planetary infrared radiation, and aerodynamic heating during final phase of decaying orbit. Mathematical models are formed and used to compose computer program for thermal design and for environmental effects evaluation. Modes of heat transfer in underdense materials, interfacial conductance between materials in space and others are considered in the development of thermal control for spacecraft. G.G.

N70-18702*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
SPACE STATION SAFETY STUDY Final Oral Review
27 Jan. 1970 96 p
(Contract NAS9-9046)
(NASA-CR-102167; D2-113070-3) Avail: CFSTI CSCL 22B

Studied were safety problems of future space stations with emphasis on crew safety only during the orbital phase of the missions. All hazards and undesired events which could be identified were examined, and measures to cope with them were devised. A set of crew safety guidelines has been derived which constitutes a list of actions to be taken in order to enhance the safety of the station or base. They are on a checklist by which the management can review and evaluate future space stations from the safety standpoint. Damage containment and control procedures and actions to be taken are spelled out in some of the guidelines which have been identified by cross-references. Author

N70-18703*# TRW Systems Group, Redondo Beach, Calif. Electronic Systems Lab.
APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM: INVESTIGATION OF RECOMMENDED METHOD FOR ELIMINATING TELEMETRY SPURS
L. A. Lorio 16 Jan. 1970 25 p ref
(Contract NAS9-8166)
(NASA-CR-102173; TRW-11176-H443-R0-00) Avail: CFSTI CSCL 22B

The following results of this investigation are contained in this report: (1) the bit-rate spurs caused by filtering the biphase modulated telemetry subcarrier prior to phase modulation were reduced 27 dB in the laboratory test setup; and (2) half-bit-rate spurs, which appear when the telemetry signal is unsymmetrical in amplitude, were reduced 17 dB in the laboratory test setup. Author

N70-18770*# TRW Systems Group, Redondo Beach, Calif.
TELEVISION BROADCAST SATELLITE STUDY RESEARCH AND TECHNOLOGY IMPLICATIONS REPORT
J. Jansen 28 Jan. 1970 14 p
(Contract NAS3-9707)
(NASA-CR-72637) Avail: CFSTI CSCL 22B

Defined and examined in detail are technological and cost factors affecting the feasibility of television broadcast satellites in the 1975 to 1980 period. Considered are the major characteristics of the following three spacecraft configurations: (1) a 12 kw, 0.9 GHz configuration with sideband amplitude-modulated vision transmission that requires the viewers to use a parabolic antenna and an adapter; (2) a 4 kw, 2.5 GHz configuration with seven frequency-modulated TV channels that requires special receiving equipment in addition to the regular television set; and (3) an 8 kw, 12 GHz configuration with one frequency-modulated television channel that also requires special equipment for reception under bad weather conditions. Parametric cost data versus performance for the spacecrafts, the special user equipment, and the master stations are obtained and the development of high power transmitter output amplifiers is outlined. Overall subsystem requirements for specific designs emphasize linearity and stability of high gain amplification, isolation between transmitter and receiver, and thermal isolation. G.G.

N70-18821*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
APOLLO SATURN 5 SPACE VEHICLE: TECHNICAL INFORMATION SUMMARY APOLLO-9 (AS-504)
3 Feb. 1969 95 p
(NASA-TM-X-62654; R-ASTR-S-69-7) Avail: CFSTI CSCL 22B

A brief and concise description of the AS-504 Apollo Saturn Space Vehicle is presented. Where necessary, for clarification, additional related information is included. The information presented herein, by text and sketches, describes launch preparation activities, launch facilities, and the space vehicle. This information permits the reader to follow the space vehicle sequence of events beginning a few hours prior to liftoff to its journey into space. Author

N70-18910*# International Business Machines Corp., Cape Kennedy, Fla.
ORBITAL GROUND CHECKOUT STUDY Executive Summary Report
17 Nov. 1969 66 p
(Contract NAS10-6376)
(NASA-CR-107232; Rept-69-M91-002-CKF) Avail: CFSTI CSCL 22B

This conceptual study analyzed the checkout and data management system requirements anticipated for the 1975-85 Space Station/Space Base Program. A 1986 Mars mission was also considered. In the light of expected technology advances, system concepts (both onboard and ground-based) were developed to satisfy the expected requirements. An implementation plan for the preferred concept of the ground-based system is presented. Author

N70-18923*# Alabama Univ. Research Inst., Huntsville.
THE APOLLO STRUCTURAL DAMPING STUDY: DETERMINATION OF MODAL DAMPING FOR LAUNCH VEHICLES USING EXPERIMENTAL DATA Final Technical Report
R. R. Reed Feb. 1969 126 p refs
(Contract NAS8-2110-8)
(NASA-CR-108088; UARI-84) Avail: CFSTI CSCL 22B

During the dynamics tests of the Saturn V - Apollo vehicle sufficient data was obtained to evaluate the modal damping forces. In this study both linear and nonlinear damping forces are investigated. To accomplish this required the development of analytical and empirical techniques not presently available in the literature. It also required some conditioning of the raw experimental data. The conclusion is that a nonlinear damping force will yield results much more consistent than those using linear damping. Numerical values are given for the first two modes of two Saturn V - Apollo configurations. Considerable differences between resonant amplitudes using linear damping compared with nonlinear damping are noted when the results are extrapolated to force levels above those used in the tests. Linear viscous damping is shown to be very conservative as far as the structure is concerned. Author

N70-19042# Boeing Co., Seattle, Wash.
AN ELECTROSTATIC CHARGE PHENOMENON ASSOCIATED WITH MINUTEMAN MISSILE FLIGHTS
J. C. Axtell and T. C. Oakberg *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 202–221 refs (See N70-19027 07-02)
Avail: CFSTI

A system problem associated with the accumulation of electrostatic charge by the Minuteman missile is described. The circumstances of two missile flight failures and the results of the failure analysis are discussed. A series of rocket motor diagnostic tests is described, and the corrective measures taken to prevent recurrence of the failures are detailed. Author

N70-19052# Martin Marietta Corp., Baltimore, Md.
ELECTROSTATIC INTERFERENCE BY FLUOROCARBON COOLANTS
Robert W. Ellison *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 385–399 refs (See N70-19027 07-02)
Avail: CFSTI

A problem with an inertial guidance system was identified in electrostatic failures of ground equipment. Test series were conducted on large panels of the payload fairing to gain further insight into the charging mechanism. Results of liquid electrostatic tests are described with a simple set up for measuring the tendency of liquids to charge. Recent tests with prototype and test hardware verified the hypothesis that fluorocarbon-75 coolants do charge Teflon hoses, and spark-through holes in Teflon hoses were located and photographed. Design criteria are recommended to amend specifications to include electrostatic phenomena and to cover behavior in electromagnetic compatibility tests. J.A.M.

N70-19163*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-56, VOLUME 1 FOR THE PERIOD 1 JANUARY TO 28 FEBRUARY 1969. FLIGHT PROJECTS
31 Mar. 1969 52 p refs
(Contract NAS7-100)
(NASA-CR-108093; JPL-SPS-37-56-Vol-1) Avail: CFSTI CSCL 22A

Three planetary-interplanetary programs are described; these are the Mariner Mars 1969 Project, the Mariner Mars 1971 Project, and the Viking Project-Orbiter System and project support. For each project, the mission objectives and project status are reported. Project engineering, systems, telecommunications, guidance and control, and space sciences tasks are cited for the Mariner Mars 1969 Project. A telecommunications study in the stability of magnetic tapes in spacecraft environments and guidance and control tasks are described for the Mariner Mars 1971 Project. Space science and guidance and control tasks in the Viking Project, and the Orbiter power subsystem are also described. M.H.E.

N70-19180*# McDonnell-Douglas Astronautics Co., Titusville, Fla.
OPTIMIZED COST/PERFORMANCE DESIGN METHODOLOGY. VOLUME 1: SUMMARY
1 Sep. 1969 30 p
(Contract NAS2-5022)
(NASA-CR-73410; MDC-E0004-Vol-1) Avail: CFSTI CSCL 22B

The broad objectives of this study were to gather historical cost and performance data, organize and analyze the data so that cost estimating relationships could be developed, and evaluate several system concepts for space logistics support. The primary source of historical cost data was the Gemini and Saturn Programs and cost estimating relationships draw extensively on this experience. A range of reuse concepts were evaluated and optimum (least cost) concepts defined for a variety of program options. These include variations in such things as crew size, cargo capacity, program requirements, etc. for either ballistic or lifting body (M2-F2) entry vehicles. Author

N70-19181*# McDonnell-Douglas Astronautics Co., Titusville, Fla.
OPTIMIZED COST/PERFORMANCE DESIGN METHODOLOGY. VOLUME 2: DATA REVIEW AND ANALYSIS. BOOK 5: COST
15 Apr. 1969 225 p refs
(Contract NAS2-5022)
(NASA-CR-73415; G975-Vol-2-Bk-5) Avail: CFSTI CSCL 22B

The purpose of the optimized cost performance design methodology study was to provide a method of using cost as a basic design parameter in identifying and defining more economical space transportation systems. The work accomplished in Task 1 is reported. The objectives were to: 1. Define a cost element structure for the purpose of cataloging and identifying cost history and formating the cost model. 2. Organize the cost history from the Gemini program and the Saturn S-IVB program into the cost element structure. 3. Develop cost estimating relationships from the available cost history and vehicle physical and functional characteristics. Author

N70-19182*# McDonnell-Douglas Astronautics Co., Titusville, Fla.
OPTIMIZED COST/PERFORMANCE DESIGN METHODOLOGY. VOLUME 2: DATA REVIEW AND ANALYSIS. BOOK 1: DESIGN
15 Apr. 1969 94 p refs
(Contract NAS2-5022)
(NASA-CR-73411; G975-Vol-2-Bk-1) Avail: CFSTI CSCL 22B

The optimized cost performance design methodology study seeks to provide a method of using cost as a basic design parameter in defining more economical space transportation systems. The work performed in Task 2 is reported. Objectives were to: (1) Define mission parameters and characteristics for a logistics mission to resupply a 12-man space station in a 300 na mi earth orbit. (2) Derive the functional and performance requirements for the several spacecraft subsystems. These requirements must cover a range of reuse categories ranging from completely expendable to completely reusable space vehicles. (3) Define alternate concepts for the spacecraft subsystems. These concepts are to include simple and sophisticated, current and advanced technology, and light and heavy concepts. Author

N70-19183*# McDonnell-Douglas Astronautics Co., Titusville, Fla.
OPTIMIZED COST/PERFORMANCE DESIGN METHODOLOGY. VOLUME 2: DATA REVIEW AND ANALYSIS: BOOK 2: PROGRAM PLANS AND DATA
15 Apr. 1969 88 p refs
(Contract NAS2-5022)
(NASA-CR-73412; G975-Vol-2-Bk-2) Avail: CFSTI CSCL 22B

The purpose of the optimized cost performance design methodology study was to provide a method of using cost as a basic design parameter in identifying and defining more economical space transportation systems. The work accomplished in Task 3 is reported. The objectives were to: (1) Define the development plans and schedules for the two spacecraft types, by subsystem and vehicle system as a function of the degree of reuseability, and the amount of integral propulsion. (2) Define the operational costs in manhours, dollars, or other resources for the operational activities from pre-launch through launch, on-orbit operations, deorbit, recovery, and recertification for each of the vehicles. Author

N70-19184*# McDonnell-Douglas Astronautics Co., Titusville, Fla.
OPTIMIZED COST/PERFORMANCE DESIGN METHODOLOGY. VOLUME 3: CONCEPT ANALYSIS AND MODEL DEVELOPMENT. BOOK 1: CONCEPT ANALYSIS
1 Sep. 1969 118 p
(Contract NAS2-5022)
(NASA-CR-73416; MDC-E0005-Vol-3-Bk-1) Avail: CFSTI CSCL 22B

The optimized cost performance design methodology study seeks to provide a method of using cost as a basic design parameter

in identifying and defining more economical space transportation systems. The work performed in Task 6 is reported. The objectives were to: (1) Synthesize systems for cost analysis using the alternate parameters defined in Tasks 2 and 3. (2) Compare and evaluate the synthesized systems to optimize the spacecraft and operations. (3) Determine sensitivity of program costs as program parameters are varied. The data resulting from the evaluation are based on the analysis of historical programs and thus, reflect the development and operational philosophies employed on these programs. However, the data obtained from the cost model is broken down in sufficient detail that the analyst has complete visibility of how the costs accrue and can apply his own adjustments to reflect a cost reduction philosophy. Author

N70-19185*# McDonnell-Douglas Astronautics Co., Titusville, Fla.
OPTIMIZED COST/PERFORMANCE DESIGN METHODOLOGY. VOLUME 3: CONCEPT ANALYSIS AND MODEL DEVELOPMENT. BOOK 2: MODEL FORMULATION
1 Sep. 1969 356 p
(Contract NAS2-5022)
(NASA-CR-73417; MDC-E0005-Vol-3-Bk-2) Avail: CFSTI CSCL 22B

The purpose of the optimized cost performance design methodology study was to provide a method of using cost as a basic design parameter in identifying and defining more economical space transportation systems. Work accomplished in Tasks 4 and 5 is reported. The objectives were to: (1) Adapt an existing sizing model to the requirements of this study and program. (2) Develop the necessary optimization scope and logic to accomplish the purpose of the study. (3) Develop the subroutines and models necessary to impelement the logic developed. (4) Perfect the methods for varying the vehicle or operational specifications systematically. (5) Provide data outputs in suitable form and format to give necessary visibility to the user. Author

N70-19237# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON COMPUTING THE CONTROL FUNCTION FOR MAXIMUM CLIMB OF A SOUNDING ROCKET
V. Ia. Gaikin 1969 21 p refs Transl. into ENGLISH from the book 'Vychislit. Metody i Programmir.', no. 12, Moscow, Univ. Press, 1969 p 87-100
Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

A parametric representation is derived for the optimizing function of the fuel consumption per second for the optimal control problem of maximum vertical climb of a missile in air. Also examined are questions of numerically finding the most advantageous mass flow rate. Computations of the optimal controls and the extremal motion parameters are illustrated in particular aerodynamic drag problems. After the law for the fuel consumption per second has been obtained as a synthesizing function of the phase coordinates, numerical computations of the optimal motion parameters together with the control functions are performed. Author

N70-19252# California Univ., Livermore. Lawrence Radiation Lab.
REMOTE METALLOGRAPHY FACILITY AT LAWRENCE RADIATION LABORATORY
E. D. Albrecht and J. M. Johnson 29 Aug. 1969 32 p refs Presented at the 2d Ann. Tech. Meeting of Intern. Metallographic Soc., San Francisco
(UCRL-71612; CONF-690920-1) Avail: CFSTI

A remote metallographic facility was installed in beta-gamma hot cells. Four of these cells were devoted to metallography in an effort to prevent contamination of the polishing, etching, and viewing areas by the grinding operation. A preliminary preparation cell was equipped with a remotized mounting press, specimen edge beveler, and two lapping machines used for two-step specimen grinding. The polishing cell has accommodations for five interchangeable rotating or vibratory polishing machines mounted at floor height. Remote microscopes are installed in the polishing and chemical etching cells. The final cell houses a cathodic etcher and a remotized B and L metallograph. The three working cells are equipped with ultrasonic cleaners which are used after each step in specimen preparation. Cell cleanliness is maintained by use of a central home-type vacuum system and wall-to-wall, stainless steel trays to contain spillage. An electron-microprobe analyzer, capable of handling a 100-curie specimen, is housed in the cell area and specimens are transferred from the polishing cell to the probe by a shielded cart. Author (NSA)

N70-19292*# NUS Corp., Rockville, Md.
UNMANNED SPACECRAFT RTG SHIELD OPTIMIZATION STUDY Midterm Report
J. J. Steyn and R. Huang Aug. 1969 63 p refs
(Contract NAS5-11649)
(NASA-CR-108225; NUS-600) Avail: CFSTI CSCL 22B

The progress of development of analytic procedures and computer codes is discussed for prediction of weight optimized radioisotope thermal generator shields for unmanned spacecraft operating in a vacuum. An optimization code designed to determine shield optimum weights and dimensions with respect to specified criterion fast neutron plus gamma photon fluxes is described. The code employs a combination of analytic, albedo, and Monte Carlo techniques. A theoretical discussion and example predicted shield data are given. Author

N70-19303*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.
DYNAMICS AND CONTROL OF FLEXIBLE SPACE VEHICLES
P. W. Likins 15 Jan. 1970 89 p refs Revised
(Contract NAS7-100)
(NASA-CR-108209; JPL-TR-32-1329-Rev-1) Avail: CFSTI CSCL 22B

The purpose of this report is twofold: (1) to survey the established analytic procedures for the simulation of controlled flexible space vehicles, and (2) to develop in detail methods that employ a combination of discrete and distributed ("modal") coordinates, i.e., the hybrid-coordinate methods. Analytic procedures are described in three catagories: (1) discrete-coordinate methods, (2) hybrid-coordinate methods, and (3) vehicle normal-coordinate methods. Each of these approaches is described and analyzed for its advantages and disadvantages, and each is found to have an area of applicability. The hybrid-coordinate method combines the efficiency of the vehicle normal-coordinate method with the versatility of the discrete-coordinate method, and appears to have the widest range of practical application. The results in this report have practical utility in two areas: (1) complex digital computer simulation of flexible space vehicles of arbitrary configuration subject to realistic control laws, and (2) preliminary control system design based on transfer functions for linearized models of dynamics and control laws. Author

N70-19304*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONDENSATION ON SPACECRAFT SURFACES DOWNSTREAM OF A KAUFMAN THRUSTER
Edward A. Richley and Thaine W. Reynolds 2 Jan. 1970 12 p refs
(NASA-TM-X-52746) Avail: CFSTI CSCL 22A

The preliminary results of an experiment begun in October 1969 to evaluate the effects of thruster exhaust products on surfaces located downstream of a mercury electron-bombardment ion thruster (Kaufman thruster) are presented. Results of the experiment show that more severe contamination problems may result from grid sputtering under certain conditions. Grid sputtered material, though it may be considerably smaller in magnitude than

the neutral mercury flow, will readily adsorb and not re-evaporate at the normally expected spacecraft temperatures. The problem is of general interest to the electric propulsion spacecraft designer, and of particular interest in connection with a solar cell contamination experiment to be conducted on the SERT II flight test of a Kaufman thruster. Author

N70-19445*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA SYSTEM SUPPORT FOR SURVEYOR MISSIONS 3 AND 4, VOLUME 2
N. A. Renzetti 1 Sep. 1969 341 p refs
(Contract NAS7-100)
(NASA-CR-108210; JPL-TM-33-301-Vol-2) Avail: CFSTI CSCL 22C

This report covers the Tracking and Data System (TDS) activities for Surveyors III and IV from the time the requirements on the system were established by the project objectives and the spacecraft design, through the preparation of the network-support plans, the implementation of the necessary facility configurations, the performance of the requisite tests to establish operational readiness, the support of the actual flights to the end of each mission—with a comprehensive account of the tracking operations, and an evaluation of that support. To better define the requirements on the TDS, the Surveyor mission of the spacecraft are included, as are synopses of the Surveyor III and IV flights. Associated equipment and activities of the three elements of the Deep Space Network in meeting the metric, telemetry, command, and tracking demands of the missions are documented. Tracking and telemetry summaries of the initial phases of the flights are given. Technical and statistical data concerning launch, trajectory, operating modes, tracking time, received signal levels, command lockups, data transmission and reduction are presented. Author

N70-19604*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-60, VOLUME 1 FOR THE PERIOD 1 SEPTEMBER TO 31 OCTOBER 1969. FLIGHT PROJECTS
30 Nov. 1969 55 p refs
(Contract NAS7-100)
(NASA-CR-108184; JPL-SPS-37-60-Vol-1) Copyright. Avail: CFSTI CSCL 22B

The missions of the Mariner Mars 1969, the Mariner Mars 1971, and the Viking projects are described and their status is discussed. The guidance and control systems for each of the spacecraft are reviewed. The orbiter system and support for the Viking Project are outlined. R.B.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N70-18309*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
COMPARISON OF FLAW GROWTH CHARACTERISTICS UNDER CRYOGENIC PROOF AND AMBIENT TEST CONDITIONS FOR APOLLO TITANIUM PRESSURE VESSELS Final Report
W. D. Bixler Jan. 1970 28 p refs
(Contract NAS9-10265)
(NASA-CR-102152; D2-121700-1) Avail: CFSTI CSCL 20K

The growth characteristics of flaws in 6Al-4V titanium, were subjected to cryogenic proof and ambient test conditions. Some specimens were failed in liquid nitrogen to determine the plane strain fracture toughness while others were loaded to a predetermined cryogenic proof stress level and then unloaded. The specimens that were unloaded were either observed for flow growth caused by the proof stress cycle; or subjected to a subsequent room temperature stress cycle and then observed for flaw growth. Significant flaw growth does occur during cryogenic proof testing at -320F when the stress intensity exceeds about 85 percent of K sub Ic at -320 deg. Reduced pressure vessel capability can be expected if the vessel just passes a 168 ksi cryogenic proof test at -320 F and is then subjected to a room temperature proof test at 140 ksi. No measurable flaw growth results when a pressure vessel is subjected to a room temperature stress of 105 ksi after barely passing a 168 ksi cryogenic proof test at -320 F. Author

N70-18337# Brown Univ., Providence, R.I. Div. of Engineering.
NORMAL IMPACT OF AN INFINITE ELASTIC BEAM BY A SEMI-INFINITE ELASTIC ROD
S. Ranganath Aug. 1969 36 p refs
(Contract ARPA SD-86)
(AD-696120; ARPA-E69) Avail: CFSTI CSCL 20/11

Solutions are obtained by the method of Laplace transformation for the problem of normal impact of an infinite elastic beam by a semi-infinite elastic rod. Timoshenko beam theory is used to describe the waves in the beam and elementary one-dimensional bar theory is used to describe the waves in the rod. Numerical results are presented for the velocity and the bending moment. These results are shown to agree well with experimental observations, except at early times. Author (TAB

N70-18340# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INVESTIGATION OF TURBINE-BLADE VIBRATIONS ON THE BASIS OF THE APPLIED THEORY OF TWISTED RODS OF AN ELONGATED PROFILE
O. K. Siva et al 30 Apr. 1969 11 p refs Transl. into ENGLISH from Dinam. i Prochnost Mashin, (USSR), no. 6, 1967 p 110-115
(AD-696476; FTD-HT-23-1502-68) Avail: CFSTI CSCL 21/5

A method for solving the problem of flexural-torsional vibrations of twisted blades based on the theory of B. F. Sharr is presented. The method was derived using an M-20 computer program. Taking into consideration the closeness of the natural frequencies of a rationally constructed discrete model to those of the original blade at a sufficiently small mass number, the discrete blade model was investigated assuming that its elastic properties coincide with those of the original blade. On the basis bar forms of vibrations, the vibration node lines on the blade were determined by the described method; these show a qualitatively good agreement with experimental data. The calculations revealed that on the basis of Sharrs theory of twisted bars, frequencies in the range of 6000-9000 Hz can be obtained for compressor blades with sufficient accuracy. TAB

N70-18357# Laboratoire de Recherche Balistique et Aerodynamiques, Vernon (France).
REPLACING AN ELASTIC, LIQUID-FILLED VESSEL BY A MASS SYSTEM ON SPRINGS WHEN FINDING THE DYNAMIC RESPONSES OF THE SUPPORTS FROM KNOWN VELOCITY POTENTIALS [REPRESENTATION D'UN RESERVOIR ELASTIQUE CONTENANT UN LIQUIDE PAR UN SYSTEME DE MASSES ET RESSORTS POUR DETERMINER LES REACTIONS DYNAMIQUES DE SUPPORTS DANS LE CAS DE POTENTIEL DE VITESSES CONNU]
V. Ye. Samodayev [1969] 19 p ref In FRENCH and RUSSIAN Transl. into FRENCH from Izv. Vyssh. Ucheb. Zaved, Aviats. Tekh. (Kazan), no. 2, 1968 p 12-20)
(LRBA-69-0170) Avail: CFSTI

Problems are considered which are related to calculation of the forces assumed by the supports of liquid-filled vessels when

the supports are moving. Various methods are proposed for finding the forms and frequencies of natural and forces oscillations of the elastic vessel-liquid system. The pressures which impart loading to the supports are then found by integrating the pressure on the wetted surface of the vessel. Equivalent systems are identified in the form of spring-supported masses for certain elements of flexible structures. Transl. by R.B.

N70-18365# Army Tank-Automotive Command, Warren, Mich.
FAMSNUB: A COMPUTER PROGRAM FOR DETERMINING THE FREQUENCIES AND MODE SHAPES OF NONUNIFORM BEAMS Final Technical Report
John L. Mc Farland Sep. 1969 68 p refs
(AD-696472; TACOM-TR-10561) Avail: CFSTI CSCL 13/13

FAMSNUB is a digital computer program, written in single precision FORTRAN IV for the Philco-Ford/GE 265 time-sharing system, to determine the eigenfrequencies and eigenmodes of vibration in pure bending of loaded, piece-wise continuous single-span beams supported in any one of the ten possible combinations of the following end conditions: free, guided, hinged and clamped. Continuously variable beam properties may be accommodated by appropriate subdivision of the span. The distributed mass of the beam itself is taken into account by means of field transfer matrices; this represents an advance over the usual lumped-parameter approach. To preserve numerical accuracy at the higher mode values, a modified transfer matrix method is employed. Verification solutions have been obtained on the IBM 360-50/65 using the double precision facility. Author (TAB)

N70-18374# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE DYNAMIC RESPONSE OF VARIOUS MEDIA Final Report, 19 Jun. 1964-18 Jun. 1968
Max Anliker and Chi-Chang Chao 17 Oct. 1969 15 p refs
(Contract DA-31-124-ARO(D)-223)
(AD-696459; AROD-4702.7-E) Avail: CFSTI CSCL 20/14

This report contains a summary of the research performed under the following topics: (1) a theoretical analysis of waves propagating in a bounded, heterogeneous elastic medium, (2) the transient response of an elastic half-space to a spreading surface load, (3) propagation of stress waves in a homogeneous isotropic wedge, (4) seismic wave radiation from sources moving over a finite distance, (5) the dynamic response of a fluid-filled circular cylindrical shell to pressure waves while subjected to a uniform external pressure, and (6) transmission of sounds and pulse waves in large arteries and veins. Author (TAB)

N70-18382# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USING THE NET-POINT METHOD IN STRESS ANALYSIS OF ORTHOTROPIC WINGS WITH SMALL ASPECT RATIO
K. A. Zhakov 30 Apr. 1969 21 p refs Transl. into ENGLISH from Vopr. Prochnosti i Ustoichivosti (USSR), no. 2, 1967 p 78-95
(AD-696305; FTD-HT-23-1316-68) Avail: CFSTI CSCL 1/3

An examination was made of bending of a low aspect orthotropic wing for different cases of retention: retention over the entire side chord, retention on a part of a chord, and retention on part of a chord with point supports. The load is presumed to be arbitrarily distributed. The problem is solved within the theory of bending of orthotropic plates of variable thickness by the method of finite differences. Such a solution permits taking into account the variability of sections and different moduli of elasticity at any point. The method of finite differences permits taking into account various important boundary conditions and makes it possible to utilize computer techniques, since the simplicity of the mathematical apparatus and the similarity of the calculations simplify programming for computers. TAB

N70-18401 National Lending Library for Science and Technology, Boston Spa (England).
AN EXPERIMENT ON THE EFFECT OF INDUCTION HARDENING ON FATIGUE STRENGTH. (REPORT 5: AN EXPERIMENT IN RELATION TO FATIGUE CRACK PROPAGATION]
Masao Shimizu et al Sep. 1969 20 p refs Transl. into ENGLISH from Nihon Kikai Gakkai Ronbonshu (Japan), v. 30, no. 215, 1964 p 780-788
(NLL-RTS-5304) Avail: Natl. Lending Library, Boston Spa, Eng.: 22s 6d or 3 NLL photocopy coupons

An experimental investigation was undertaken to study the fatigue crack propagation in an induction hardened V-notched specimen of C=0.16% steel. The experimental results may be summarized as follows: (1) Fatigue cracks were detected in extremely early stages of stress repetitions. For example, at the higher stress level of 70 kg/m sq m the first crack was detected at 150 repetitions. (2) It was observed that the rate of crack propagation was maximum at the early time and decreased as the crack grew. This phenomena can be interpreted by using the concept of the stress at the crack-tip under the presence of the residual compressive stress. (3) It was found that there was a simple relation between the calculated stress and the rate of crack propagation. (4) The rate of crack propagation in the specimen subjected to the varying stress amplitude in two or three stages was studied. It appears that the rate of crack propagation depends upon its stress history and is accelerated by varying the stress amplitude. Author

N70-18404# Naval Research Lab., Washington, D.C. Shock and Vibration Information Center.
THE SHOCK AND VIBRATION BULLETIN, NO. 39, PART 2
Feb. 1969 243 p refs Proc. of Symp. on Shock and Vibration, Pacific Grove, Calif. 22-24 Oct. 1968
(AD-688445; Bull-39-pt-2) Avail: CFSTI CSCL 20/11

The conference papers presented pertain to vibration testing in relation to elastomers, missiles, holograms, hydraulics, resonance, deceleration, structural modes, sound pressures, and the Apollo and Mariner projects. For individual titles, see N70-18405 through N70-18425.

N70-18410# Grumman Aircraft Engineering Corp., Bethpage, N.Y.
RESPONSE OF AN ELASTIC STRUCTURE INVOLVING CROSS CORRELATIONS BETWEEN TWO RANDOMLY VARYING EXCITATION FORCES
A. Razziano and J. R. Curreri (Polytech. Inst. of Brooklyn, N.Y.) *In* Naval Res. Lab. The Shock and Vibration Bull. No. 39, Pt. 2 Feb. 1969 p 51-61 refs (See N70-18404 07-32)
Avail: CFSTI

The results of an investigation to show the importance of considering cross correlations between shaker inputs in environmental vibration tests is presented. General responses to two random loadings that are uncorrelated, directly correlated, and having various time lags are determined. The general equations were then applied to a simply supported beam, and response curves plotted for a point on the beam for the three random input cases. The beam response at the prescribed location will then obviously be the input to any piece of equipment mounted at that point. These response curves reveal the magnitude of errors involved when cross correlation between the two shaker inputs is not taken into consideration. Author

N70-18413*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE USE OF LIQUID SQUEEZE-FILMS TO SUPPORT VIBRATING LOADS
Brantley R. Hanks *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 77-86 refs (See N70-18404 07-32)
Avail: CFSTI

The bond strength of liquid squeeze-films subjected to oscillating loads normal to the plane of the film was investigated. A mass with a flat circular bottom was placed on a rigid flat covered with a thin layer of liquid. A sinusoidal oscillation was then imparted to the base, and the acceleration level necessary to break

the bond of the liquid film was measured under both atmospheric anf vacuum ambient pressure conditions. The effects of a number of variables, in particular the mass, contact area, oscillatory frequency, fluid vapor pressure, viscosity, and surface tension, were considered. Results indicated that liquid squeeze-films can be used to support vibrating loads of considerable magnitude, even in a vacuum environment. The limiting factor on the bond strength was found to be the fluid cavitation pressure which can be negative. Ap analysis was developed based on Reynolds lubrication theory and was found to predict the basic trends of the data. Author

N70-18415# Naval Missile Center, Point Magu, Calif.
ENVIRONMENTAL LABORATORY MISSILE FAILURE RATE TEST WITH AERODYNAMIC FUNCTION SIMULATION
Raymond C. Binder and Gerald E. Berge *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 99–103 (See N70-18404 07-32)
Avail: CFSTI

Results of an investigation to improve the present laboratory missile failure rate test are presented. The missile was installed in an environment chamber and exercised with an aerodynamic functional simulator and an oscillating target. A test arrangement is described in which the guidance and control system effective navigation ratio and time constant are measured. The ratio and time constant are clear, definite, and significant parameters for testing and evaluating the missile. While exercised by the simulator, the missile undergoes failure rate tests under various conditions, such as vibration, shock, humidity, temperature, and altitude. During the test, malfunctions and failures were detected and the exact time of failure was identified. Author

N70-18417*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MODAL SURVEY RESULTS FROM THE MARINER MARS 1969 SPACECRAFT
R. E. Freeland and W. J. Gaugh (Northrop Corp., Hawthorne, Calif.) *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 123–133 refs (See N70-18404 07-32)
(Contract NAS7-100)
Avail: CFSTI CSCL 20K

The objectives and techniques of a test program to determine the spacecraft modal characteristics are described. The modal survey results of the Mariner 1969 development test model are presented. Generalized mass matrix calculations are shown to evaluate the validity of the test data and the mass distribution. Typical test mode shapes and frequencies are correlated with values obtained from analysis. Author

N70-18418# Chrysler Corp., New Orleans, La. Space Div.
UPRATED SATURN 1 FULL SCALE DYNAMIC TEST CORRELATION
Charles R. Wells and John E. Hord *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 135-146 refs (See N70-18404 07-32)
Avail: CFSTI

A full scale vibration test was conducted for the Uprated Saturn 1 vehicle to determine its bending and torsion frequencies and mode shapes. A brief description and the correlation of these tests with theoretical results of a multibeam dynamic model currently being used to generate bending and torsion modes of the clustered tank Uprated Saturn 1 vehicle configuration are presented. Good correlation is shown in most cases. Author

N70-18419# General Electric Co., Philadelphia, Pa.
AN APPROACH FOR DUPLICATING SPACECRAFT FLIGHT-INDUCED BODY FORCES IN A LABORATORY
S. M. Kaplan and A. J. Soroka *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 147-156 refs (See N70-18404 07-32)
Avail: CFSTI

A test approach is described which is capable of imparting both internal and external body forces to a test article that effectively duplicates loadings expected in flight. This sinusoidal vibration test approach employs existing test equipment. The test levels remain invarient, barring major redesign. This approach advocates the tailoring of the test environments to the specific spacecraft. Author

N70-18422# Collins Radio Co., Cedar Rapids, Iowa.
VIBRATION EQUIVALENCE: FACT OR FICTION?
La Verne Root *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 187–194 refs (See N70-18404 07-32)
Avail: CFSTI

Several equivalence theories are discussed and the controversial aspects of vibration equivalence are outlined. The contents of a monograph on vibration equivalence are outlined and it is shown how the monograph may be used to improve the equivalence between laboratory tests and field vibration. Author

N70-18423# General Dynamics/Pomona, Calif.
PROVIDING REALISTIC VIBRATION TEST ENVIRONMENTS TO TACTICAL GUIDED MISSILES
K. R. Jackman and H. L. Holt *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 195–216 refs (See N70-18404 07-32)
Avail: CFSTI

Descriptive information on functional and test capabilities of the environmental equipment for quality assurance testing of a medium sized missile sections in assemblies is provided. A review of test philosophies adopted by most missile and aircraft companies in the United States is given. Author

N70-18424*# Honeywell, Inc., Seattle, Wash.
THE REDUCTION OF THE VIBRATION LEVEL OF A CIRCULAR SHAFT MOVING TRANSVERSELY THROUGH WATER AT THE CRITICAL REYNOLD'S NUMBER
Irvin F. Gerks *In* Naval Res. Lab. The Shock and Vibration Bull., No. 39, Pt. 2 Feb. 1969 p 217–220 (See N70-18404 07-32)
Avail: CFSTI

Instrument tests performed on a slender, circular shaft moving transversely through water at speeds up to 8 feet per second indicated two vibrational modes: fore and aft, and lateral. These modes occurred at different speeds and were apparently caused by different exciting phenomena. A hypothesis was formed about these phenomena and a corrective solution was derived. Three model shafts were tested and one whose design embodied the solution displayed very little fore and aft vibration throughout the entire speed range. Author

N70-18430# Marquette Univ., Milwaukee, Wis. Dept. of Civil Engineering.
STUDY OF THE FLEXURAL-TORSIONAL BUCKLING BEHAVIOR OF PLANAR STRUCTURES. PART 1: FLEXURAL-TORSIONAL BUCKLING BEHAVIOR OF PARTIALLY YIELDED STRUCTURES. PART 2: EXPERIMENTAL STUDY OF THE FLEXURAL-TORSIONAL BUCKLING BEHAVIOR OF ELASTIC PLANAR STRUCTURES
Alois J. Hartmann Jul. 1969 77 p refs
(Grant NSF GK-1497)
Avail: Issuing Activity

The research program consisted of two separate studies. In the first phase, a method of evaluating the effects of structural continuity and elastic lateral bracing stiffness on the flexural-torsional buckling behavior of partially yielded planar structures was developed and applied to the analysis of simply supported beams subject to various loading conditions. In the second phase, an experimental study was made of the effect of elastic stiffness of lateral bracing on the elastic flexural-torsional

buckling behavior of one and two span beams and of rigid frames. Author

N70-18481*# National Aeronautics and Space Administration, Washington, D.C.
VIBRATION OF PLATES
Arthur W. Leissa (Ohio State Univ) 1969 360 p refs
(NASA-SP-160) Avail: SOD $3.50; CFSTI CSCL 20K

The analytical results from theories on plate vibration are presented to reduce research duplication, and to provide accurate and complete numerical results for testing new methods. The fundamental equations of classical plate theory, including the coordinate systems are reviewed, and angular frequency data are presented for the following plates: circular, elliptical, rectangular, parallelogram, other quadrilateral, triangular, other shapes, anisotropic, with inplane forces, and of variable thickness. F.O.S.

N70-18504 National Lending Library for Science and Technology, Boston Spa (England).
THE BOUNDARY CONDITION OF A PLATE WEAKENED BY A SYSTEM OF CRACKS LYING ALONG A LINE AT AN ANGLE TO THE DIRECTION OF EXTENSION [O PREDELNOM RAVNOVECII PLASTINY, OSLABLENNOI SISTEMOI TRESHIN, RASPOLOZHENNYKH VDOL PRYAMOI POD UGLOM V NAPRAVLENII RASTYAZHENIYA]
L. T. Berezhnitskii Dec. 1969 8 p refs Transl. into ENGLISH from Kontsentratsiya Napryazh. (USSR), no. 1, 1965 p 46-52
(NLL-RTS-5510) Avail: Natl. Lending Library, Boston Spa, Engl.: 17s 6d or 2 NLL photocopy coupons

The boundary equilibrium condition of an infinite elastic plate weakened by linear cracks disposed along a coincident line whose direction lies at some angle to the line of application of tensile force is considered. It is assumed that the edges of the cracks are free from external stresses and that uniformly distributed, monotonically increasing forces directed at an angle to the axis of the cracks are applied at infinitely distant points on the plate. Based on the hypothesis that the initial direction of propagation of a randomly orientated linear crack coincides with the direction of the radial plane on which the normal tensile stresses attain their maximum intensity, relationships were obtained for determining the limiting values of the external forces. A formula is developed for determining the concentration coefficients of the stresses and applied to variative cases of the problem considered. Results indicate the assumed hypothesis is valid and that the initial direction of crack propagation depends only upon the orientation of the line of the cracks and not upon the coordinates of their ends. D.L.G.

N70-18508# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A LIGHTENED CURVILINEAR BAR FOR LONGITUDINAL-TRANSVERSE BENDING
R. V. Chelnokov 12 Mar. 1969 18 p refs Transl. into ENGLISH from Aviats. Inst., Kazan. Tr. (USSR), no. 91, 1966 p 113-125
(AD-696505; FTD-HT-23-1207-68) Avail: CFSTI CSCL 13/13

An effort is made to obtain a closed form solution and to design a curvilinear bar of uniform strength for longitudinal-transverse bending with simultaneously varying cross-sectional height and width. The problem is formulated as follows: for given initial conditions, the laws of variation are wanted for the sizes of cross sections taken along the bars axis such that the maximal stresses in any section along the bar axis are equal to the design stresses, and the greatest displacement does not exceed the maximum allowable displacement. Another requirement of the solution is that the difference in the curvatures of any segments of the deformed bar be constant. The author demonstrates that, subject to certain assumptions, a closed form solution can be found for several sets of design conditions. The solution method makes it possible to find the displacement and the moment of inertia of bar cross sections which meet the problem conditions. TAB

N70-18568# Naval Civil Engineering Lab., Port Hueneme, Calif.
STRUCTURAL RESPONSE OF UNSTIFFENED TOROIDAL SHELLS Technical Report, Sep. 1967-Apr. 1969
W. J. Nordell, J. E. Crawford, and R. M. Beard Nov. 1969 27 p refs
(AD-697274; NCEL-TR-649) Avail: CFSTI CSCL 13/13

Seven model epoxy toroidal shells were tested, and the results were compared with those from analytical solutions. The toroidal shells had a mean radius about the axis of revolution of 6 inches, a mean tube radius of 2 inches, and a mean shell thickness of 0.086 inch. The static elastic strain response of the epoxy models was in satisfactory agreement with that computed using a finite element analysis for axisymmetric shells. Critical buckling pressures for the models were approximately 85% of the analytical prediction, which was based on the mean dimensions. Author (TAB)

N70-18593*# Utah Univ., Salt Lake City. Mechanical Engineering Dept.
DEVELOPMENT AND TESTING OF A BALLISTIC IMPACT LOADING DEVICE
Dolores Labranche Simonson (M.S. Thesis) Jun. 1970 61 p refs
(Grants NGR-45-003-029; NSF GK-2188)
(NASA-CR-108081) Avail: CFSTI CSCL 20K

A simple, economical device for producing cumulative shock loading in materials was investigated, designed, and tested. The device developed uses a ballistic impact driven projectile to introduce high stress waves into the material. By adjusting design parameters, the impact time and load amplitude are varied to produce fracture with one load or several loads in polymethyl methacrylate (PMMA) rods. The wave front was examined as it travels through the PMMA rod and identified as approaching a square wave front. Materials other than PMMA were loaded to failure to demonstrate the scope of the loading apparatus. Fracture morphologies in the materials were microscopically examined and described with reference to established fracture modes. Author

N70-18627# Gulf General Atomic, San Diego, Calif.
ON COMPUTATIONAL METHODS IN SOLID MECHANICS AND STRESS ANALYSIS
Y. R. Rashid *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 503-518 refs (See N70-18594 07-22)
Avail: CFSTI

Progress made in the various areas of the finite element method for the solution of problems in solid mechanics and stress analysis is discussed. Computational problems in solid mechanics generally begin with identification of a structure's configuration and its environment. The former defines the geometry of the structure, which may be one of many types, such as a beam, plate, shell, or general three-dimensional solid. The latter, the environment, imposes on the geometry a set of governing equations which consist of strain-displacement relations, constitutive equations, compatibility relations, boundary conditions, and equilibrium equations. Both the geometry and the environment strongly influence the selection of computational procedure appropriate to the problem. The development of computational methods in solid mechanics has emphasized variational procedures. The finite element method evolved as an extension of the Rayleigh-Ritz procedure and has become the most extensively used numerical technique in computational mechanics. Author (NSA)

N70-18629# Sandia Corp., Albuquerque, N.Mex.
NUMERICAL ANALYSIS OF TWO-DIMENSIONAL, DYNAMIC, THERMAL STRESSES IN A HOLLOW CYLINDER
J. A. Reuscher and M. R. Scott *In* Am. Nucl. Soc. Proc. of the Conf. on the effective use of Computers in the Nucl. Ind. [1969] p 542-560 refs (See N70-18594 07-22)
Avail: CFSTI

The finite difference technique for solving the dynamic thermo-elastic displacement equations is described. The technique provides good agreement between calculated results and measured values. The program CADETS can perform about 3.6 × 10 to 5th power mesh point calculations of u and v per minute of computer time on the CDC-6600. Hollow cylinders with varying lengths and diameters were successfully run with CADETS as long as stability was maintained by the proper choice of Delta t/Delta r and Delta z/Delta r. Author (NSA)

N70-18663# Houston Univ., Tex. Dept. of Mechanical Engineering.
FORCED VIBRATIONS OF DAMPED SYSTEMS WITH BILINEAR NONSYMMETRIC ELASTICITY
J. Mandke and C. D. Michalopoulos Aug. 1969 45 p refs
(Contract Nonr-4492(01))
(AD-697284; TR-18) Avail: CFSTI CSCL 20/11

A single degree-of-freedom viscously damped system with bilinear, nonsymmetric restoring force is analyzed. The differential equations governing the motion of the system are solved in closed form by matching the solutions for the positive and negative parts of a cycle. The fourth order Runge-Kutta method is also employed to solve the system numerically. Steady-state response curves are plotted for several ratios of the spring constants and damping. Both force and motion inputs are considered. Author (TAB)

N70-18680# Naval Civil Engineering Lab., Port Hueneme, Calif.
WINDOWS FOR EXTERNAL OR INTERNAL HYDROSTATIC PRESSURE VESSELS. PART 4. CONICAL ACRYLIC WINDOWS UNDER LONG-TERM PRESSURE APPLICATION AT 20,000 PSI Technical Report, 1 Jul. 1967-30 Jun. 1968
J. D. Stachiw Oct. 1969 128 p refs
(AD-697272; NCEL-TR-645) Avail: CFSTI CSCL 13/13

Conical acrylic windows of 30-, 60-, 90-, 120-, and 150-degree included angles have been subjected in their mounting flanges to 20,000 psi of hydrostatic pressure for up to 1,000 hours in the 32F-to-75F temperature range. The displacements of the windows through the flange mounting have been recorded and are graphically presented as a function of time, temperature, conical angle, and thickness-to-diameter ratio for the ready reference of the designer. A detailed study has also been made of the types of failure and of the dimensional and structural parameters that must be considered in the design of safe, operationally acceptable windows for long-term service under hydrostatic pressure of 20,000 psi. The test results indicate that a minimum thickness to minor diameter ratio of 2 and an included conical angle of 90 degrees or larger is required to provide safe and optically acceptable windows for long-term sustained pressure loadings of 20,000 psi. Author (TAB)

N70-18694 National Lending Library For Science and Technology, Boston Spa (England).
CRACK INITIATION AND PROPAGATION AT MULTIPLE REPEATED STRESS IN MANY STRESS LEVELS
Itsuro Aoki et al Sep. 1969 16 p refs Transl. into ENGLISH from Zairyo (Kyoto), v. 15, no. 149, Feb. 1969 p 95-101
(NLL-RTS-5298) Avail: Natl. Lending Library, Boston Spa, Engl.: 7s 6d or 2 NLL photocopy coupons

Failure point, crack initiating point, and crack propagation process are discussed. Fatigue in two separate steps is analyzed, first up to the crack initiation period and then during the crack propagation period. The test was made by means of a rotary bending fatigue testing machine, using as specimen a low carbon steel bar with a V shaped notch. The results obtained are: (1) The rate of crack propagation is low when the crack is initiated, then it shows a sudden increase after a certain depth of the crack is attained. This may be attributed to the stress concentration on the crack which begins to show crack-tip. (2) The repeated cycle stress effect prior to crack initiation on the width of the crack and the number of the crack initiating cycle seems to follow the linear damage law. Author

N70-18780*# North Carolina State Univ., Raleigh.
SOME ONE DIMENSIONAL SOLUTIONS OF NONLINEAR WAVES OF A RATE SENSITIVE, ELASTOPLASTIC MATERIAL Technical Report, 1 Sep. 1967-31 Aug. 1972
E. E. Burniston and T. S. Chang Jan. 1970 38 p refs
(Grant NGL-34-002-084; Contract N00014-68-A-0187; ARPA Order 1090)
(NASA-CR-108100; TR-70-1) Avail: CFSTI CSCL 20L

Two classes of closed form solutions of one-dimensional nonlinear waves of a rate-sensitive, elastoplastic material are reported. One class is self-similar and the other class consists of constant speed propagations. Applications of these solutions to unsteady motions behind propagating discontinuities are also considered. Author

N70-18791# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
THE DYNAMIC INTERACTION BETWEEN STRUCTURAL ELEMENTS AND VARIOUS CONTINUOUS MEDIA Final Report, 13 Feb. 1964-15 Jun. 1969
George Herrmann Jun. 1969 6 p refs
(Contracts DA-ARO(D)-31-124-G534; DA-ARO(D)-31-124-G823)
(AD-697195; AROD-4550-14-E) Avail: CFSTI CSCL 13/13

The Report summarizes an effort to determine several aspects of dynamic interaction of plates and shells on one hand and various fluid and solid continuous media on the other. Author (TAB)

N70-18824 New Mexico Univ., Albuquerque.
ELASTIC WAVE PROPAGATION IN THIN CONICAL SHELLS
Paul Nelson Sonnenburg (Ph.D. Thesis) 1968 118 p
Avail: Univ. Microfilms: HC $5.80/Microfilm $3.00 Order No. 69-9284

Theoretical results were compared with experimental data obtained by impacting a truncated shell with a steel ball. The method of solving the equations yielded continuous wave forms which could be compared directly with strain gage data. The general simultaneous equations for the conical shell were obtained and reduced to a single equation with longitudinal displacement as the unknown. Singularities were analyzed for physical meaning and simplifications were made by considering the low and high frequency ranges separately. Dependence on the conical angle and Poisson's ratio was not lost. The simplified equations were identified as special cases of the multi-dimensional wave equation, which has been studied previously in other branches of physics. Recognition of the general wave equation led to an investigation of wave propagation in multi-dimensional space. Of the two unique types of solutions known to be available, the solution for radiating waves was found to be applicable and compared favorably with the experimental data. Dissert. Abstr.

N70-18863 Case Western Reserve Univ., Cleveland, Ohio.
THE SIGNIFICANCE OF TOUGHNESS IN THE MECHANICAL BEHAVIOR OF A TWO COMPONENT SYSTEM
Frank Thomas Krotine (Ph.D. Thesis) 1968 173 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 69-9416

The mechanism of fracture initiation in carburized steels was related to the development of a rheological interaction between the two components of the system, the case and the core. The development of an interfacial interaction in bending was described in terms of the material properties of the separate components. It was determined that the case-core interaction stems from the differences in the flow characteristics of the case and the core. The resulting complex stress state pin-pointed crack initiation at the case-core interface. The temperature transition properties exhibited by carburized bend specimens supported the concept that the case-core interaction in bending is the controlling factor in the

overall behavior. The characteristics of the load-deflection curves of carburized bars were interpreted in terms of the complex stress state described by the behavioral model. This model rationalized the initiation of plastic flow, the subsequent temperature dependence of the bend ductility, and the overall flow stress of the composite. Dissert. Abstr.

N70-18867 Wisconsin Univ., Madison.
HYBRID COMPUTER METHODS OF STRUCTURAL ANALYSIS AND SYNTHESIS
Alain Henri Peyrot (Ph.D. Thesis) 1968 165 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 68-16015

In this investigation studies are made of the potential uses of hybrid computation in solutions of structural analysis and synthesis problems. Dynamic behavior of structural systems may be observed by making an analog solution of the controlling differential equations; or more automatically, the required basic data can be generated directly from the configuration of the structure and its member properties. Problems of structural synthesis by hybrid computation are studied through fully stressed designs of indeterminate trusses, beams or rigid frames with multiple loading conditions. It is shown that optimum design parameters can be obtained quickly from the electrical model. This investigation shows that elastic, plastic, stability and vibration analyses, as well as fully stressed designs of structures, may be performed very rapidly by hybrid computation, thus allowing fast human interaction. It may be concluded that hybrid computers should play a more active role in the field of civil engineering. Dissert. Abstr.

N70-18871 Duke Univ., Durham, N.C.
FINITE ELEMENT ANALYSIS OF OPEN SHELLS OF REVOLUTION UNDER NONSYMMETRICAL LOADING
George Kyle Coffin (Ph.D. Thesis) 1968 191 p
Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 69-9456

A finite element, stiffness procedure for the elastic analysis of open shells of revolution under nonsymmetrical loading and general support conditions is developed. The procedure is based on a simplified element for which the stiffness matrix can be readily formulated and programmed in terms of concise analytical solutions. Convergence and accuracy of the solution procedure is illustrated. The finite elements are based on a cone of linearly varying thickness and on a constant thickness right circular cylinder. The benefits of expressing the element displacements and stress resultants in complex form are discussed from an analytical and programming viewpoint. Convergence of the cone solution to the cylinder solution is illustrated by examining the effect on the stiffness matrix as the cone angle approaches 90 degrees. For the constant thickness hyperboloid shell under wind load, the finite element solution is shown to be in close agreement with published results of a finite difference analysis. Dissert. Abstr.

N70-18937*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANALYTICAL VIBRATION STUDY OF A RING-STIFFENED CONICAL SHELL AND COMPARISON WITH EXPERIMENT
John L. Sewall and Donnell S. Catherines Washington Feb. 1970 59 p
(NASA-TN-D-5863; L-6747) Avail: CFSTI CSCL 20K

A Rayleigh-Ritz vibration analysis employing the concept of chosen modes is described and applied to a ring-stiffened, truncated, clamped-free, conical shell for which experimental vibration data are available for comparison. Power-series functions are employed to approximate meridional components of the in-plane and normal displacements, and the rings are treated as discrete elements of arbitrary cross section. In addition to the primary extensional and bending stiffnesses of the ring, together with its mass and centroid location inside or outside the shell wall, other so-called secondary stiffnesses and inertias are included to account for out-of-plane bending, cross-sectional asymmetry, warping, rotatory inertia, and the meridional centroid position relative to the ring attachment point. Good agreement between experimental and analytical frequencies and mode shapes was obtained for the shell with a ring of rectangular cross section attached near the clamped end and with rings of Z-shaped cross section attached at different stations along the shell meridian. Author

N70-18968 National Lending Library for Science and Technology, Boston Spa (England).
THE STABILITY OF AN ASYNCHRONOUS MOTOR UNDER SHOCK LOADING
O. M. Sosnin 20 Aug. 1969 10 p refs Transl. into ENGLISH from Elektrotechnika (Budapest), v. 39, no. 4, 1969 p 9-12 (NLL-CE-Trans-5007-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A stability criterion and calculation method are proposed for determining possible overloads and mains voltage drop in asynchronous motors operating under shock loads. R.B.

N70-19064 California Inst. of Tech., Pasadena.
BUCKLING OF CYLINDRICAL SHELLS WITH RANDOM IMPERFECTIONS
Rene Scher Fersht (Ph.D. Thesis) 1968 88 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 69-502

The buckling stability analysis of long cylindrical shells with random imperfections subjected to axial load is treated using two different approaches. The first study is based on a Liapunov method which enables one to establish sufficient conditions for buckling stability of a long cylindrical shell with axisymmetric random imperfections. A perturbed system of equations in the neighborhood of the prebuckling solution is investigated. The second part is based on the approximate method of truncated hierarchy. The prebuckling state of equilibrium for asymmetric imperfections is found by a successive substitution technique. A homogeneous variational system of equations is set up in order to examine the existence of bifurcation in the neighborhood of the equilibrium state. These last equations involve random parametric terms. The truncated hierarchy method is applied and characteristic equations are obtained. Various exponential cosine correlation functions associated with asymmetric imperfections are examined numerically. Dissert. Abstr.

N70-19119*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NEWTON-RAPHSON CONJUGATE-GRADIENT TECHNIQUE FOR CALCULATION OF AXISYMMETRIC BUCKLING OF SHALLOW SPHERICAL SHELLS WITH VARIABLE EDGE CONSTRAINT
Harry G.Schaeffer Washington Feb. 1970 31 p refs (NASA-TN-D-5664; L-5959) Avail: CFSTI CSCL 20L

The feasibility of utilizing mathematical programming techniques for determining stable equilibrium states of nonlinear structural systems is explored. The physical problem chosen for evaluation of this methodology was the nonlinear behavior of a shallow spherical shell subjected to uniform pressure. The procedure found most useful was a hybrid method consisting principally of a generalized Newton-Raphson technique with intermittent application of the conjugate-gradient search technique. The variation of buckling pressure with changes in edge restraint and shell geometry is found for a uniformly loaded shell. Author

N70-19153# Lockheed Missiles and Space Co., Palo Alto, Calif.
EXPERIMENTAL INVESTIGATION OF TOROIDAL SHELL STABILITY
Iu. A. Fedosov 1969 5 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Aviats. Tekhn. (Kazan), no. 3, 1969 p 154-157

Avail: National Translations Center, John Crerar Library, Chicago, Ill. 60616

The stability of closed toroidal shells of circular cross section subjected to a statically applied external pressure is investigated. The buckling was studied initially on nonmetallic shells. It is shown that the most intensive wave formation is observed in domains adjoining the lines with zero curvature. This suggests production of metal models consisting of two symmetric halves, but welded along the equatorial circles of the torus. R.B.

N70-19174*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE FLUTTER OF FLAT BUILT-UP PANELS UNDER STREAMWISE INPLANE LOAD

Robert W. Hess Washington Feb. 1970 88 p refs

(NASA-TR-R-330; L-6640) Avail: CFSTI CSCL 20L

The flutter of 13 panels subject to streamwise inplane load at Mach numbers of 1.57 and 1.96 has been investigated. Panel length-width ratios ranged from 1 to 4.2. The experimental flutter boundary was compared with an analytical flutter boundary for six of the panels. Damping, both aerodynamic and structural, was found to have a pronounced effect on the analytical flutter boundary. The agreement between analysis and experiment was dependent upon how structural damping was introduced in the formulation of the problem. Author

N70-19192*# Techtran Corp., Glen Burnie, Md.

EXPERIMENTAL AND THEORETICAL STUDIES OF THE FORCES AND MOTIONS IN THE CONTACT AREA OF FREE-ROLLING TIRES

Norbert Seitz Washington NASA Feb. 1970 151 p refs Transl. into ENGLISH of the book 'Experimentelle und Theoretische Untersuchungen der in der Augstandsflache Frei Rollender Reifen Wirkenden Krafte und Bewegungen' Germany, 1969 193 p

(Contract NASw-1695)

(NASA-TT-F-12710) Avail: CFSTI CSCL 13F

Pressures, shear forces and motions in tire contact areas are measured simultaneously with the aid of a new drum-type test stand. Using a special control device, it is possible to approach any measuring point on the periphery of a tire within + or - 1 mm. In the tests, conducted at peripheral speeds up to 120 km/hr, the effects of tire construction, geometry and physical experimental conditions are taken into consideration. Author

N70-19231*# Techtran Corp., Glen Burnie, Md.

STATIC AND FATIGUE STRENGTH OF END-CLOSED FILAMENT WOUND VESSELS UNDER INTERNAL PRESSURE

Yukihiko Takenaka et al Washington NASA Feb. 1970 6 p refs Transl. into ENGLISH from J. Japan Soc. Aeron. and Space Sci. v. 17, Mar. 1969 p 118-120

(Contract NASw-1695)

(NASA-TT-F-12818) Avail: CFSTI CSCL 20K

Two test studies of end-closed filament wound vessels are described. The first is concerning manufacture of filament-wound vessels that have more than 80 kg/sq mm maximum hoop stress at burst pressure. The second is concerning the relationship between cyclic internal pressure and fatigue life of vessels that hold 80 kg/sq mm hoop stress. Results obtained from the tests were: (1) End-closed filament-wound vessels having 80 kg/sq mm hoop stress were manufactured; (2) An expression for the relationship between cyclic internal pressure and fatigue life was established. Author

N70-19312 Stanford Univ., Calif.

ANALYSIS OF STIFFENED PLATES BY THE FINITE ELEMENT METHOD

Robert Parker Mc Bean (Ph.D. Thesis) 1968 164 p

Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 69-8219

In this work, refined finite elements are used to obtain the most accurate practical approach to the analysis of plates with torsionally weak, eccentric rib stiffening. The structural system is idealized as an assemblage of compatible plane stress, plate bending, and stiffener finite elements. The mathematical development of the stiffness method from the principle of minimum potential energy is carefully documented, including the rationale for selection of displacement functions. Then the finite elements required for the "best" idealization are developed. A stiffener element that is compatible with the quadrilateral plate elements is derived. Any solution based on this combination of elements provides a lower bound on the strain energy. The stress and consistent load matrices are included. Thirty two degrees of freedom are associated with each plate element, ten with each stiffener element. Numerical examples for plane stress and plate bending are used to prove the excellent behavior of the plate elements. Then four stiffened plate problems are solved. Dissert. Abstr.

N70-19323*# Cincinnati Univ., Ohio.

THE GENERAL MOTION OF A VARIABLE-MASS FLEXIBLE ROCKET WITH INTERNAL FLOW

Leonard Meirovitch Washington NASA Feb. 1970 65 p refs

(Grant NGR-36-004-030)

(NASA-CR-1528) Avail: CFSTI CSCL 20K

In the first part of the paper a new and general formulation of the dynamical problems associated with the powered flight of a flexible, variable-mass rocket with internal flow is presented. The formulation comprises six ordinary differential equations for the rigid-body motion and three partial differential equations for the elastic motion, with the appropriate boundary conditions. For a critical examination of the dynamic characteristics of variable-mass bodies, in the second part of the paper an analytical solution of the boundary-value problems with time-dependent coefficients associated with the longitudinal and transverse vibrations of an axially symmetric, variable-mass, spinning rocket, is obtained under certain assumptions. This paper scrutinizes the concept of normal-mode vibration for a variable-mass boost vehicle. Its results can be used to check the measure of validity of the so-called "time-slice" procedure based on this concept, particularly in the case of solid-fuel rockets for which the mass variation is quite rapid. Author

N70-19392*# Polytechnic Inst. of Brooklyn, N.Y. Aerospace Engineering and Applied Mechanics Dept.

FREE VIBRATIONS OF CIRCULAR CYLINDER WEB-STIFFENED SANDWICH SHELLS

David Ranlet, Youl-Nan Chen, and Joseph Kempner 1970 98 p

(Grant NGT-33-006-003; Contract NONr-839(39); NR Proj. 064-167)

(NASA-CR-108216; PIBAL-70-1) Avail: CFSTI CSCL 20K

Presented herein is an analysis of the free vibrations of simply supported and clamped, web-stiffened, circular, cylindrical sandwich shells. The mathematical model formulated includes the effect of translatory and rotatory inertia in each layer of the sandwich, and threats the two face layers as thin shells in which the classical (Donnell) theory of shells applies. Shear deformations, however, are permitted in the core, which is treated as a layer of inhomogeneous, orthotropic material. In the analysis, the discrete nature of the webs is maintained, except for the inclusion of an average secondary shear modulus induced by the bending of the webs and faces. Equations are also developed for the free vibrations of the corresponding homogeneously cored sandwich shells, in order to investigate the effect of smearing-out or averaging a given web-stiffened core. A Galerkin procedure is employed to determine the natural frequencies from a variational functional generated by means of Hamilton's principle. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N70-18360# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).

THE INSTABILITY OF THE MECHANISM OF SEQUENTIAL SELF-IGNITION OF FUEL IN THE CHAMBER OF A ROCKET ENGINE [INSTABILITE DU MECANISME D'AUTO-INFLAMMATION SUCCESSIVE DU PROPERGOL DANS LA CHAMBRE D'UN MOTOR-FUSEE]

S. K. Aslanov [1969] 10 p refs In FRENCH and RUSSIAN Transl. into FRENCH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 2, 1968 p 49-52
(LRBA-69-0171) Avail: CFSTI

The stability of the combustion front is analyzed with respect to one-dimensional perturbations which displace the plane of the flame, i.e. the behavior of the combustion process is examined in the induction mode relative to small variations in the expansion of the induction zone between the end of the rocket engine chamber and the combustion front. Study of the eigenvalues of the ensuing boundary value problem determines the criterion of instability. Combining this problem with the obtained criterion of front instability to the curves permits conclusions to be made about the instability of the mechanism of sequential self-ignition in the rocket engine chamber. Transl. by R.B.

N70-18383 National Lending Library for Science and Technology, Boston Spa (England).

INFLUENCES AFFECTING THE INTRINSIC SAFETY OF ELECTRIC CIRCUITS . . . [BEEINFLUSSUNG DER EIGENSICHERHEIT VON ELEKTRISCHEN STROMKREISEN]

K. H. Gehm 28 Jul. 1969 7 p refs Transl. into ENGLISH from PTB Mitt. (German), v. 79, no. 2, Apr. 1969 p 90-92
(NLL-SMRE-Trans-5747-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

A test bomb was constructed in the lid of which two ducts were inserted in addition to the gas pipes and spark plugs to investigate the influence of leakage currents on the intrinsic and nonintrinsic safe electric circuits. Measurement results presented in graphical form show that nonintrinsically safe circuits with voltages up to 220 V and intrinsically safe circuits in a flameproof enclosure may be feasible as long as the intrinsically safe circuits are not placed in zones in which the risk of occurrences of dangerous quantities of explosive mixtures is present. Test results were reproducible with fluctuations of about + or — 10%. J.M.C.

N70-18387# Naval Civil Engineering Lab., Port Hueneme Calif.

THE EFFECT OF GEOMETRIC FACTORS IN BOILING HEAT TRANSFER EQUIPMENT Technical Note

Allan S. Hodgson Oct. 1969 23 p refs
(AD-696969; NCEL-TN-1061) Avail: CFSTI CSCL 13/1

The effect of geometric factors in boiling heat transfer has been reviewed. The factors such as length, rod bundle geometry, bends, obstructions, weld intrusions have all been found to have some effect on boiling heat transfer coefficients. Empirical correlations are available to predict many of the effects of these factors but others are virtually ignored. An experimental program is recommended to evaluate the effects of geometric factors on boiling heat transfer coefficients, commencing with an investigation of tube bundle performance with variable geometric parameters. TAB

N70-18444# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HEAT TRANSFER IN A GAS-TUBE BUNDLE EXPOSED TO SOUND VIBRATIONS

L. G. Gelfenbein et al 23 Sep. 1969 7 p refs Transl. into ENGLISH from Akust. i Ultrazvuk. (USSR), no. 3, 1968 p 53-58
(AD-696329; FTD-HT-23-257-69) Avail: CFSTI CSCL 20/4

An experimental setup makes it possible to determine the heat exchange coefficient in each row of a gas pipe cluster during a transverse exposure to intense sound. The setup consisted of an aerodynamic tube containing a cluster of pipes in which hot water was circulated. Cold air flow was maintained past the pipes in the heat exchanger. Resistance thermometers were used to measure water and air temperatures. An acoustic motor-driven siren was used as the generator of intense sound. The motor speed was variable between 150 and 2500 rpm. The sound pressure was measured by a piezoelectric microphone. The intensity distribution pattern which was obtained indicated good axial symmetry of the sound field. The decrease in sound intensity due to passage through the heat exchanger was 20 db. During all experiments, the sound intensity was maintained constant. An increase in the heat exchange coefficient due to the effects of sound was observed. A frequency dependence was also established, with low sound frequencies being more effective. The volume resonance in the heat exchanger apparently had the effect of also increasing the efficiency of the heat exchange. TAB

N70-18516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE USE OF COMPUTERS TO CALCULATE THE COMBUSTION CHAMBERS OF GAS TURBINES OPERATING ON NATURAL GAS

A. A. Shatil et al 27 Aug. 1969 21 p refs Transl. into ENGLISH from Energ. Mashinostr. (USSR), no. 5, 1967 p 66-76
(AD-696236; FTD-MT-24-180-69) Avail: CFSTI CSCL 21/5

The introduction of computer technology makes it possible to calculate the combustion processes and heat transfer in gas turbine combustion chambers. In such a problem, the mathematical model includes all known physico-chemical interactions of the parameters of the process and the minimum number of experimental coefficients. Experimental studies in such cases are limited to the determination of these coefficients and to the verification of the correctness of the mathematical model. The accumulated experimental information and its analysis are sufficient to outline a method for carrying out calculations of telescopic single, swirl-cup combustion chambers operating on natural gas. In this calculation method, it is assumed that the flame and wall temperatures and the heat fluxes along the length are constant and equal to the means of their corresponding values. This assumption varies little from the actual process which takes place in a combustion chamber. The method is based on four formulas: (1) the heat liberation formula; (2) the heat removal (balance to the combustion chamber); (3) the heat transfer formula; and (4) the heat balance at the combustion chamber wall. Author (TAB)

N70-18552# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.

INFLUENCE OF ACCELERATION ON SUBCOOLED NUCLEATE BOILING

Ross L. Judd (Ph.D. Thesis and Herman Merte, Jr. (Ph.D. Thesis) Jan. 1969 266 p refs
(Grant NSF GK-1296)
Avail: CFSTI

The influence of acceleration and subcooling upon the rate of heat removal in nucleate boiling and the results of these parameters upon the boundary layer thickness, the number of active nucleation sites per unit area, the frequency of vapour bubble emission and the maximum bubble size in particular are investigated. The results comprise a consistent set of measurements pertaining to Freon boiling on an oxide coated glass heating surface for

various combinations of heat flux ranging from 4,000 BTU/hr sq ft to 40,000 BTU/hr sq ft, subcooling ranging from 0 F to 50 F and acceleration ranging from 1 to 100 times standard gravitational acceleration. Author

N70-18630*# General Electric Co., Sunnyvale, Calif. Breeder Reactor Development Operation.
AN EXPLICIT UNLIMITED STABILITY APPROACH TO THE TRANSIENT CONDUCTION-CONVECTION EQUATIONS
David J. Bender *In* Am. Nucl. Soc. Proc. of the Conf. on the Effective Use of Computers in the Nucl. Ind. [1969] p 561-585 refs (See N70-18594 07-22)
Avail: CFSTI

Postulating an axial section of a reactor channel to be the basic nodal unit for transient heat transfer calculations, a finite difference method of calculating the convective heat transfer was developed and checked with sample problems, and found to be superior to existing methods. As the convective model was explicit and not stability limited, it was coupled to an existing explicit, unlimited stability scheme formulated by Levy for the fuel, clad and structural node temperatures. Finally, determination of an effective time step criteria to take advantage of the unlimited stability nature of the equations has resulted in an efficient and accurate nodal model for the analysis of transient heat transfer in a reactor core. Author (NSA)

N70-18686*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROCEEDINGS OF THE THIRD SOUTHEASTERN SEMINAR ON THERMAL SCIENCES
H. L. Atkins and R. I. Vachon, eds. 8 May 1968 236 p refs Conf. held at Huntsville, Ala., 8-9 May 1967 Prepared in cooperation with Auburn Univ.
(NASA-TM-X-62639; MISC-SSL-69-1) Avail: CFSTI CSCL 20M

Discussed are various studies on heat and mass transfer, thermodynamics, fluid mechanics, and energy conversion of interest for space flight applications. The factors involved in the determination and prevention of aerodynamic heating of bodies traveling at hypersonic speeds are presented and numerous approximate solutions and mathematical models are formed to solve the thermodynamic problems. G.G.

N70-18688*# Michigan Univ., Ann Arbor.
LOW TEMPERATURE THERMODYNAMICS
Richard E. Sonntag *In* NASA. Marshall Space Flight Center Proc. of the Third Southeastern Seminar on Thermal Sci. 8 May 1968 p 55-72 refs (See N70-18686 07-33)
Avail: CFSTI CSCL 20M

The purpose of this discussion is to consider the low temperature region, in which problems of thermodynamic phase behavior become of fundamental interest and importance. Two classes of processes in which phase equilibrium problems arise will be discussed, with particular emphasis on the low temperature system hydrogen-helium. Author

N70-18792# Notre Dame Univ., Ind. Coll. of Engineering.
THE INFLUENCE OF THERMAL RADIATION IN TRANSIENT THERMAL BOUNDARY LAYERS
Kwang-Tzu Yang, Jerome L. Novotny, and John W. Pitz Sep. 1969 42 p refs
(Contract N00014-68-A-0152; Proj. Themis)
(AD-697304; THEMIS-UND-69-8) Avail: CFSTI CSCL 20/13

The investigation examined the effect of an absorbing-emitting gas in a laminar boundary layer near a two-dimensional stagnation point where the wall undergoes a step change in temperature. The flow is considered to be incompressible and steady. The analysis is based on appropriate asymptotic expansions valid for small times. These expansions are matched in the asymptotic sense for small and large values of the physical coordinate. Steady-state solutions for representative cases are also given. Results are presented for a general gray gas formulation, and a nongray and a gray formulation for CO2 under specific conditions. Author (TAB)

N70-18828*# McDonnell-Douglas Co., Santa Monica, Calif.
STAGNATION POINT HEAT TRANSFER DURING HYPERVELOCITY ATMOSPHERIC ENTRY
W. S. Rigdon, R. B. Dirling, Jr., and M. Thomas Washington NASA Feb. 1970 83 p refs
(Contract NAS1-7757)
(NASA-CR-1462; DAC-63243) Avail: CFSTI CSCL 20M

Stagnation point heat transfer solutions have been generated for selected conditions of altitude, velocity, nose radius, and mass injection at the wall. For these solutions the radiative transfer has been computed considering the detailed spectral radiative properties of both air and ablation products including atomic line transitions. The effects of the thermodynamic and transport properties of ablation products on the heat flux at the wall have been investigated, and radiative preheating of the ambient air has been considered. The results have shown that ablation products are less effective in reducing the radiative flux to the wall than previously predicted. The investigation of an approximate semi-local formulation for the net radiant emission has revealed the unsuitability of this technique for analyzing high temperature shock layers. Comparison of the detailed solutions with other less exact methods, e.g., line grouping, for calculating the radiative transfer in ablating body shock layers has shown the necessity for retaining full spectral detail in the description of the radiative properties. Author

N70-18828*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC AND ROCKET-EXHAUST HEATING DURING LAUNCH AND ASCENT NASA Space Vehicle Design Criteria (Structures)
May 1969 33 p refs
(NASA-SP-8029) Avail: CFSTI CSCL 20M

Heat transfer due to external aerodynamic flow and rocket exhaust are studied during the launch and ascent phase of flight to develop design criteria for space vehicles. Aerodynamic heating is discussed in terms of flow field determination, trajectories, atmospheric data, vehicle geometry, protuberance heating, and venting. The flow field determination, plume impingement, radiation, base heating, and venting of rocket-exhaust plume heating are analyzed. Tests and recommended practices are presented, and a list of NASA space vehicle design criteria monographs issued to date is included. F.O.S.

N70-18839 New Mexico Univ., Albuquerque.
THE THERMAL CONDUCTIVITY OF LIQUID HELIUM 4 AND LIQUID HELIUM 3
Jerry Francis Kerrisk (Ph.D. Thesis) 1968 204 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 69-9254

The thermal conductivity of liquid He-4 (helium I region) was measured between 1.77 K and 3.95 K, and the thermal conductivity of liquid He-3 was measured between 1.5 K and 3.95 K, both at pressures up to 34 atm. With He-4, special attention was given to the vicinity of the lambda-transition, where data were taken. With He-3, the critical region was given special attention. The thermal conductivity of He-4 and He-3 gas at low pressure was also measured between 1.5 K and 3.95 K. Measurements were made using a steady state method with a fixed separation parallel plate apparatus. Heat was produced electrically in the upper plate and passed through the 0.0323 inch thick helium layer to the lower plate. The usual guard heater arrangement was avoided by providing an evacuated space around the upper plate and cell wall. Dissert. Abstr.

N70-18860 Pittsburgh Univ., Pa.
LOCAL HEAT TRANSFER DOWNSTREAM OF ABRUPT EXPANSION IN CIRCULAR CHANNEL WITH SUBSONIC TURBULENT AIR FLOW
Peter Paul Zemanick (Ph.D. Thesis) 1968 236 p
Avail: Univ. Microfilms: HC $10.80/Microfilm $3.05 Order No. 69-8583

Local Nusselt numbers in the region beyond an abrupt expansion in a circular channel are determined. The effort included both analytic and experimental work on the problem. An analytic model was formulated for both a two-dimensional and a cylindrical channel expansion. Experimental work with air as the working fluid was performed for three expansion geometries, ratios of upstream-to-downstream diameter of 0.43, 0.54, and 0.82. Although data were collected for downstream Reynolds numbers of 5,000 to 90,000, some higher Reynolds number data for the two lower ratios had to be discarded because of the tendency toward axial asymmetry at high flow rates with the more extreme expansions. Dissert. Abstr.

N70-18868 Virginia Polytechnic Inst., Blacksburg.
LAMINAR AND TURBULENT CONVECTIVE HEAT TRANSFER OVER BODIES AT AN ANGLE OF ATTACK
Tsze Cheng Tai (Ph.D. Thesis) 1969 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 69-9935

The axisymmetric analogue (small cross flow approximation) is employed to develop methods for calculating laminar and turbulent heat transfer over bodies of revolution at angles of attack. These methods are restricted to hypersonic flows over bodies with highly cooled walls. A method is presented for determining the surface inviscid streamline geometry and coordinate scale factors, which are required in the axisymmetric analogue. This method requires the surface pressure distribution to be known, whether theoretical or experimental. A theoretical pressure distribution is developed using combinations of modified Newtonian pressures, Prandtl-Meyer relations, and the second order shock expansion method. It was found that the surface pressure distribution affected laminar heating rates more than the inviscid streamline geometry. The choice of reference conditions and the exponent in the viscosity-temperature relationship highly affected the turbulent heating rates. Dissert. Abstr.

N70-18893*# Techtran Corp., Glen Burnie, Md.
AN EXPERIMENTAL INVESTIGATION OF THE TURBULENT BOUNDARY LAYER ON A SMOOTH PLATE WITH A GRADUATED HEAT SUPPLY [EKSPERIMENTALNOYE ISSLEDOVANIYE TURBULENTNOGO POGRANICHNOGO SLOYA NA GLADKOY PLASTINE PRI STUPENCHATOM PODVODE TEPLA]
V. P. Lebedev Washington NASA Jan. 1970 7 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 4, Jul-Aug. 1969 p 112-115
(Contract NASw-1695)
(NASA-TT-F-12773) Avail: CFSTI CSCL 20M

Results are discussed of an experimental heat exchange investigation in connection with a graduated heat supply to a flat wall. The experimental temperature profiles and heat exchange data obtained confirm a hypothesis previously advanced to the effect that ordinary heat exchange laws are valid in this case of the difference between equilibrium and factural wall temperatures. Author

N70-18948 National Lending Library for Science and Technology, Boston Spa (England).
ISOTHERMAL MODELLING OF THE FLOW OF GASES IN COMBUSTION CHAMBERS WITH BURNERS OF CIRCULAR SECTION
J. Zelkowski 20 Aug. 1969 12 p refs Transl. into ENGLISH from Biul. Inst. Energetyki (Polish), v. 9, no. 9-10, Sep.-Oct. 1967 p 65-66
(NLL-CE-Trans-5162-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: .1 NLL photocopy coupons

The flow of combustion gases in the combustion chambers of boiler installations burning pulverized coal fuel are investigated in a model having an enlarged burner. The initial length of the jet cone depends on the diameter of the burner orifice. Retraction of the burners in a direction counter to the gas flow in the jet improves the simulation of the fuel-combustion installation by the model burners. The relative values of retraction of the model burner are given. R.B.

N70-18955*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A TURBOJET COMBUSTOR USING NATURAL GAS FUEL HEATED TO 1200 F (922 K)
James S. Fear and Robert R. Tacina Washington Feb. 1970 20 p refs
(NASA-TN-D-5672; E-5264) Avail: CFSTI CSCL 20M

Combustion efficiency was determined using natural gas fuel over a range of injection temperatures from ambient to 1200 F. The combustor was comprised of three U-gutter flameholders mounted downstream of a trumpet-shaped diffuser in a rectangular housing. A simple film cooled liner was used. Tests were conducted at ambient pressure over a range of fuel air ratios and combustor reference velocities. Increases in efficiency of more than 40 percentage points were achieved at the higher fuel temperatures. The results are applicable to natural gas afterburner design and to the design of advanced low-pressure-loss primary combustors. Author

N70-18957*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL HEAT-TRANSFER DISTRIBUTIONS ON A BLUNT LIFTING BODY AT MACH 3.71
Robert L. Stallings, Jr., Robert L. Wright, and Ida K. Collins Washington Feb. 1970 67 p refs
(NASA-TN-D-5616; L-6765) Avail: CFSTI CSCL 20M

The composite body consisted of a spherical nose segment, a delta-slab upper surface with blunt leading edges, wedge sides, and a conical lower surface. The tests were conducted both with and without roughness on the model for a range of angle of attack up to 40 deg. Included is a complete tabulation of the experimental heating rates and a discussion of the more significant findings. Author

N70-18985*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TESTS OF A SINGLE-TUBE-IN-SHELL WATER BOILER WITH HELICAL-WIRE INSERT, INLET NOZZLE, AND TWO DIFFERENT INLET-REGION PLUGS
James R. Stone and Nick J. Sekas Washington Feb. 1970 46 p refs
(NASA-TN-D-5644; E-5282) Avail: CFSTI CSCL 20M

Experimental data were obtained on the performance of a vertical-upflow, single-tube-in-shell water boiler with full-length helical-wire insert, 0.0235 in. throat-diameter inlet nozzle, and two different inlet-region plugs of lengths 1.78 and 10 in. (4.52 and 25.4 cm). The boiler tube had an inner diameter of 0.436 in. and an effective heated length of 60.5 in. Steady-state pressure drop and heat transfer data were obtained over a range of boiling fluid flow rates and pressures, both with and without vaporization in the nozzle. Boiler feed conditions ranged from a liquid subcooling of 180 F to a flashing condition of 0.04 vapor quality. The highest exist vapor quality obtained was 0.98, but with measured vapor superheat as great as 105 F. Steadystate heat transfer and pressure drop data were compared with existing plain-tube correlations. There were no significant differences in boiler pressure drop or heat transfer performance for the two different plug lengths. Author

N70-18988 National Lending Library for Science and Technology, Boston Spa (England).
ON THE QUESTION OF HEAT EMISSION UNDER CONDITIONS OF FILM CONDENSATION OF IMMOBILE STEAM
L. D. Bergman et al Sep. 1969 8 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), No. 2, 1969 p 47-48
(NLL-RTS-5292) Avail: Natl. Lending Libary, Boston Spa, Engl.: 5s or 1 NLL photocopy coupon

Clarifications are presented for formulas, expressions and definitions used earlier in documenting a study on heat emission during film condensation of immobile steam. E.M.C.

N70-19011*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TURBOJET COMBUSTOR PERFORMANCE WITH NATURAL GAS FUEL
Nicholas R. Marchionna and Arthur M. Trout Washington Feb. 1970 34 p refs
(NASA-TN-D-5571; E-5204) Avail: CFSTI CSCL 21B

Natural gas fuel for advanced turbojet combustor applications was investigated with two swirl-can modular-combustors. Tests were conducted at a combustor inlet pressure of 45 psia, inlet temperatures of 540 and 1140 F and reference velocities up to 190 ft/sec. The efficiency of both combustors was near 100 percent for inlet air temperatures of 1140 F. However, at inlet air temperatures of 540 F, the efficiency of one design decreased rapidly with decreasing fuel-air ratio. Acoustical instabilities, encountered with both combustors as initially designed, disappeared when the blockage at the module exit plane was sufficiently increased. Altitude blowout and ignition performance was poorer than that of a JP-fueled combustor of similar design. Vitiated preheat inlet air had an important adverse effect on combustion efficiency. Author

N70-19012 Texas A&M Univ., College Station.
AN EXPERIMENTAL AND MATHEMATICAL STUDY OF IN SITU COMBUSTION IN A SEGREGATED SYSTEM
Chakib Khelil (Ph.D. Thesis) 1968 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 69-8485

The objectives are to study experimentally the factors affecting oxygen consumption and oil recovery in a segregated system and to provide a better mathematical means for estimating the distribution of temperature, oxygen, and fuel throughout the reservoir. Nine combustion tube runs were made wherein all of the factors involved in the process were studied. The objectives were then fulfilled by correlating the data obtained from material balance by means of a multiple regression analysis program. The results showed that burning in a segregated system is characterized by the fingering of the coke zone, the formation of secondary surfaces of combustion, low pressure gradients, and migration of oil into the gas cap. There is more even oxygen consumption at low than at high flux and pressure. Oxygen consumption increases as flux, pressure, or clay content increases but increases as water saturation or oil gravity increases. The recovery of initial oil in place increases as crude oil gravity increases. It is also noted that recoveries in this system are substantially the same as those in similar vertical tube runs but differ in the time of oil breakthrough. Dissert. Abstr.

N70-19044# Lightning and Transients Research Inst., Minneapolis, Minn.
AIRFLOW VELOCITY EFFECTS ON LIGHTNING IGNITION OF AIRCRAFT FUEL VENT EFFLUX
James R. Stahmann *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 239-253 refs (See N70-19027 07-02)
Avail: CFSTI

A mockup of an aircraft wingtip was mounted on top a 10 million volt generator in order to produce a high velocity air flow over the surface of a wingtip. Propane, and to a limiting extent JP-4 and kerosene, were used as the igniting fuels. Vent outflow velocities were selected at 1, 2, 5, and 10 fps, and the mixtures proportioned for 0.5, 1.0, and 1.5 stoichiometric by volume. The air flow velocity was measured with a pitot tube. Tabulated results indicate that the most vulnerable mixture and flow rate were 1.5 stoich and 5 fps. J.M.C.

N70-19049# Parker-Hannifin Corp., Cleveland, Ohio.
NITROGEN INERTING OF AIRCRAFT FUEL TANKS
K. R. Bragg, C. C.Kimmel, and P. H. Jones *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 324-341 (See N70-19027 07-02)
Avail: CFSTI

A nitrogen inerting system for oxygen control in aircraft fuel tanks is described. The treating of fuel on-board and on the ground during refueling is considered. The basic system operation is concerned with the delivery of nitrogen gas into the fuel tanks to perform two functions: dilute the ullage oxygen concentration to a level that prevents ignition possibility and prevent the admission of air into the fuel tanks. Combustion processes associated with hydrocarbon fuels are also analyzed. J.M.C.

N70-19050# Bureau of Mines, Washington, D.C.
SPARK IGNITION: IGNITION OF FLAMMABLE MIXTURES AS A CONSEQUENCE OF GASEOUS ELECTRONIC DISCHARGE
Elton L. Litchfield *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 342-353 refs (See N70-19027 07-02)
Avail: CFSTI

The concept of minimum ignition energy is summarized along with conditions which must be met in order to insure that the derived energy is not from a triboelectric fluid. It is shown that mixtures of saturated straight chain hydrocarbon fuels may be ignited by the discharge of 0.25 mj energy at 1 atmosphere pressure. Electric field strength within the rank ullage is not permitted to equal or exceed the dielectric breakdown strength of the fuel-air mixture to insure complete safety. J.M.C.

N70-19051# Naval Air Propulsion Test Center, Philadelphia, Pa.
INVESTIGATION OF TURBINE FUEL FLAMMABILITY WITHIN AIRCRAFT FUEL TANKS
L. Maggitti and L. J. Nestor *In* AFSC Lightning and Static Elec. Conf., Pt. 2 May 1969 p 354-384 refs Sponsored by FAA (See N70-19027 07-02)
Avail: CFSTI

A dynamic combustion apparatus was designed to determine the flammability characteristics of turbine fuels at both static and dynamic conditions. Vibration was selected the most representative form of aircraft dynamics, and was incorporated solely for producing sprayed fuel. The fuel was maintained in the combustion vessel at the time of ignition. Through instrumentation of the apparatus, the resultant temperature and pressure rises occurring at combustion were recorded. These flammability parameters were then related to fuel type, ambient temperatures, altitudes, and fuel spray. Author

N70-19290*# Georgia Inst. of Tech., Atlanta.
THEORETICAL CALCULATIONS OF RADIANT HEAT TRANSFER PROPERTIES OF PARTICLE-SEEDED GASES
J. R. Williams, A. S. Shenoy, and J. D. Clement Washington NASA Feb. 1970 45 p refs
(Grant NGR-11-002-068)
(NASA-CR-1505) Avail: CFSTI CSCL 20M

A discussion of the mechanisms of radiant heat transfer in gases containing particles is presented. The Mie theory equations for spherical particles were used to calculate the adsorption, extinction, and scattering parameters of carbon at 3590 F, silica at 80 F, and tungsten at 76, 1530, and 2420 F over the

wavelength range for which complex refractive index data are available. The application of these results to radiant heat transfer calculations for the gaseous core nuclear rocket is discussed. Author

N70-19356*# Georgia Inst. of Tech., Atlanta.
MEASUREMENTS OF THE EXTINCTION PARAMETERS OF HOT SEEDED HYDROGEN AT 1 ATMOSPHERE PRESSURE
A. S. Shenoy, J. R. Williams, and J. D. Clement Washington NASA Feb. 1970 43 p refs
(Grant NGR-11-002-068)
(NASA-CR-1504) Avail: CFSTI CSCL 20M

The extinction parameters of carbon-hydrogen, tungsten-hydrogen, and silicon-hydrogen aerosols were measured as a function of radiation wavelength from 1200 to 6000 A at various temperatures up to 3450 F. The submicron-sized carbon particles have a relatively high extinction parameter of the order of 50,000 sq cm/gm. However, at higher temperatures the carbon particles disappear due to chemical reactions between hydrogen and carbon. The extinction parameter of tungsten particles was found to be about 10,000 to 20,000 sq cm/gm and that of silicon to be about 65,000 sq cm/gm. In all of these cases the extinction parameter is essentially independent of wavelength and temperature over the range of wavelengths and temperatures investigated. Author

N70-19487# Sandia Corp., Livermore, Calif.
TURBULENT HEATING FROM A COMPRESSIBLE BOUNDARY LAYER WITH PRESSURE GRADIENT
D. L. Hartley and P. W. Witze Oct. 1969 40 p refs
(Contract AT(29-1)-789)
(SCL-RR-69-70) Avail: CFSTI

A turbulent boundary-layer heating theory is presented which approximately accounts for the pressure gradient contributions to the integral momentum-conservation equation. The variation of similar treatments of pressure gradient found in the literature is illustrated and discussed. Numerical calculations of boundary-layer thickness and heat-transfer rate are compared with other approximate theories. Author (NSA)

N70-19649# Laboratoire de Recherches Balistiques et Aerodynamiques, Vernon (France).
HEAT TRANSFER IN PLANE CHANNEL WITH SYMMETRIC AND UNIDIRECTIONAL HEAT SUPPLY AND CONSTANT PHYSICAL PROPERTIES [TRANSFERT DE CHALEUR DANS UN CONDUIT PLAN AVEC APPORT DE CHALEUR PAR UN COTE OU DEUX COTES OPPOSES ET PROPRIETES PHYSIQUES CONSTANTES]
N. I. Melik-Pashaev [1969] 14 p refs In FRENCH and RUSSIAN
(LRBA-69-0362) Avail: CFSTI

A dual-layer flow model is examined for a viscous sublayer at a wall with dominant effects of molecular viscosity and the turbulent layer. Turbulent heat transfer is also calculated. Transl. by E.C.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N70-18369# Naval Research Lab., Washington, D.C.
REPORT OF NRL PROGRESS
Dec. 1969 45 p refs
(NAVSO-P-3012) Avail: CFSTI

Included in this research progress report are: (1) exploring the lower E region by using alkali plasma clouds as radar reflective tracers of the fluid motions in the atmosphere; (2) design of a small magnetic tape data storage system employing incremental tape advance; (3) ionization during platinum catalyzed oxidation of hydrocarbon vapors; and (4) abstracts of the research and development of individual projects of the research and development program. F.O.S.

N70-18480*# Syracuse Univ., N.Y.
REFLECTIONS ON INTERDISCIPLINARY RESEARCH
Richard J. Hopeman and David L. Wilemon Apr. 1969 22 p *Its* Occasional Paper No. 2
(Grant NGL-33-022-090)
(NASA-CR-107955) Avail: CFSTI CSCL 05A

A study was made of interdisciplinary research, both at NASA and at universities. It is felt that NASA has developed some unique management concepts which are discussed for application to university conditions. The university structure and the demands for professionalism, as well as individual differences among participants, degrees of commitment, and research management discourage interdisciplinary research within universities. The final deterrent is the nature and degree of competition among various research project members. Recommendations for the improvement of interdisciplinary research within universities are presented. J.M.

N70-18659# Office of the Director of Defense Research and Engineering, Washington, D.C. Office for Lab. Management.
EVALUATION OF RESEARCH AND DEVELOPMENT ORGANIZATIONS
E. M. Glass 31 Jul. 1969 13 p refs
(AD-697343; MAN-69-3) Avail: CFSTI CSCL 5/1

One of the problems identified by the Director of Defense Research and Engineering, in his high-priority effort to strengthen the Department of Defense in-house laboratories, concerned the evaluation of research and development organizations. The report describes a peer rating experiment which was an attempt to gain greater insight into the relationship of management and organizational performance with organizational characteristics. Author (TAB)

N70-18679# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GENERAL PHYSICS AND PLASMA DYNAMICS Quarterly Progress Report
H. J. Zimmermann, G. G. Harvey, and S. J. Mason 15 Oct. 1969 155 p refs
(Contracts DA-28-043-AMC-02536(E); N00014-67-A-0204)
(AD-696281; QPR-95) Avail: CFSTI CSCL 9/3

Contents: General physics--Hydrogen atom addition to solid isobutylene at 77K; Pulsar observations with a swept-frequency local oscillator; Search for the 1.35-cm stratospheric H2O line; Pulsar observations; Ku-band interferometer; Extended bandwidth long baseline interferometry; 60-GHz mixer; Some aspects of high dynamic range amplification; Intermodulation distortion analysis; Experimental investigation of the velocity distribution of hydrogen molecules desorbed from metal surfaces; Ultrasonic dispersion in piezoelectric semiconductors; Nonlinear interaction between a sound field and a liquid surface; Nonlinear wave distortion of acoustic-noise spectrum; Parametric cross-modulation effects in gas lasers; Parametric effects in the helium-neon gas laser; Use of addition theorems for electromagnetic field synthesis on circular cylinders and spheres; Quantization of electromagnetic radiation fields in moving uniaxial media; Plasma dynamics--Anomalous cyclotron radiation; Stability of electron beams with velocity shear; Communication sciences and engineering--Speech and audio computer-aided examination and analysis facility, TASS-another terminal analog speech synthesis system; A facility for studying

perception of timing in natural speech, On the inappropriateness of rule features, Moire patterns in sampling halftone pictures, Holography and imaging of three-dimensional objects, Survey of type font usage, Current noise in nerve membrane-some comments on measurement techniques, Comparison of two models relating the resting membrane potential of squid axon to ion concentrations, Alternate route for acoustic stimulation of a lizard inner ear, Automated system to control stimulus. TAB

N70-18913*# Stanford Research Inst., Menlo Park, Calif.
ACTIVITIES OF THE NASA SPONSORED SRI TECHNOLOGY APPLICATIONS TEAM IN TRANSFERRING AEROSPACE TECHNOLOGY TO THE PUBLIC SECTOR Quarterly Progress Report, 1 Jul.-30 Sep. 1969
William C. Thuman Oct. 1969 37 p refs
(Contract NASw-1992; SRI Proj. PAU-8368)
(NASA-CR-108139; QPR-1) Avail: CFSTI CSCL 05B

The application of aerospace technology in the fields of air pollution, criminalistics, and public transportation is outlined with emphasis on users west of the Rocky Mountains. The individualization of evidence in criminal investigation laboratories considers the measurements of reflection spectra from very small samples and the determination of immunological properties in physiological materials of great importance. Advanced technological methods are also outlined to improve design and construction of mass transportation systems and to find solutions to prevent the pollution of our environments. The development of pollution monitoring and research instruments is proposed for measuring stack effluent, size distribution of airborne particulates, gaseous reactive pollutants, odors, and meteorological indices. Biomedical problems of air pollution that need evaluation constitute preclinical indications of intoxication from air pollutants, oxygen delivery rate measurements in tissues, lung metabolic processes, and the mechanism of body histamine release. G.G.

N70-18921# National Aeronautics and Space Council, Washington, D.C.
AERONAUTICS AND SPACE REPORT OF THE PRESIDENT TRANSMITTED TO THE CONGRESS, JANUARY 1970
Jan. 1970 111 p
Avail: SOD $1.00

The scientific accomplishments in aeronautics and space programs are reported. The specific developments in the various government departments are discussed. Details are given for ground support systems, power supplies, launchings, tracking, communications, lunar exploration and aircraft safety. International cooperation, university research, and industrial activities are also presented. F.O.S.

N70-18932 New York Univ., N.Y. School of Engineering and Science.
COMPUTER SELECTION OF KEYWORDS USING WORD-FREQUENCY ANALYSIS
John Millar Carroll (Ph.D. Thesis) 1968 138 p
Avail: Univ. Microfilms: HC $6.60/Microfilm $3.00 Order No. 69-7713

A statistically based method for automatically identifying keywords in machine-readable text has been developed which selects words chosen by panels of human indexers more consistently than do most of the individual panel members and proves to be superior to five statistical methods previously proposed. This method is a linear combination of these five statistical measures and makes use of both the in-document word-occurrence frequency and the in-corpus relative occurrence frequency. Each statistical measure was compared with the performance of human indexes using rank correlation statistics. The simple word count was found to be superior to other indexers, which include the relative occurrence frequency. The tests were conducted with 19 documents in the field of information science totaling over 68,000 words, and 17 indexers representing eight different information centers. Dissert. Abs.

N70-19404*# Informatics Tisco, Inc., College Park, Md.
NASA METRIC SYSTEM STUDY
Philip F. Eckert and Owen Carlson Washington NASA Feb. 1970 35 p refs
(Contract NASw-1812)
(NASA-CR-1555) Avail: CFSTI CSCL 12A

To analyze current metric usage and trends in its usage, a survey was made of 13,143 NASA formal reports. These were the Technical Notes and Technical Memorandums originated by 11 NASA Centers. The method of assembling and identifying the selected document collection, and the procedures used for coding and tabulating the findings are described. Tabular and graphical data are grouped according to the types of measurement systems, the use of each by NASA Centers, and the report publication year. The results show that 22.0% contained metric units only; 31.7% contained English units only; 30.2% contained both units; and 16.1%, neither. Comparisons of two four-year periods, 1962-65 and 1966-69, indicate that the combined usage (metric, predominately metric, and parallel usage) increased from 33.4% to 53.2%. Author

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